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(54) **INVARIANT BIOHASH SECURITY SYSTEM AND METHOD**

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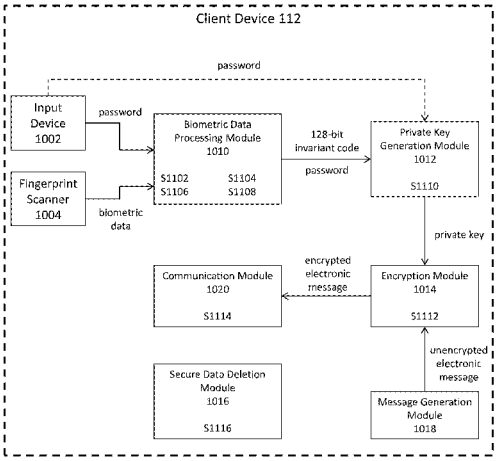
(57) **ABSTRACT**

Systems, methods, and program products for providing secure authentication for electronic messages are disclosed. A method may comprise generating an asymmetric private key based at least in part upon an invariant biometric feature vector derived from an input biometric reading. The private key may be further based at least in part upon a user password. The resulting private key may not be stored but rather may be generated when required to authenticate an electronic message, at which time it may be used to provide a digital signature for the electronic message. The private key may be deleted after use. The private key may be regenerated by inputting both a new instance of the biometric reading as well as a new instance of the password.

20 Claims, 37 Drawing Sheets



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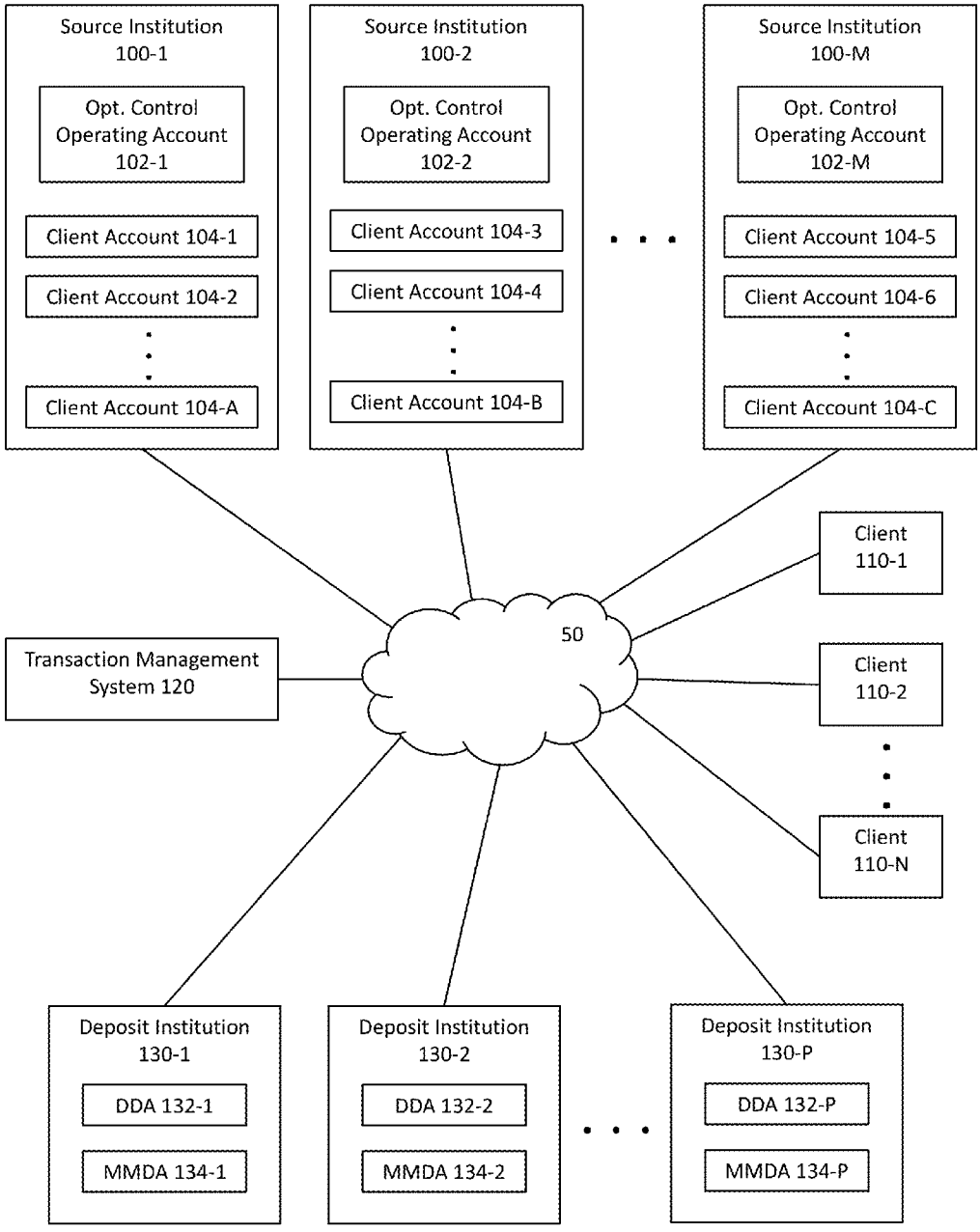
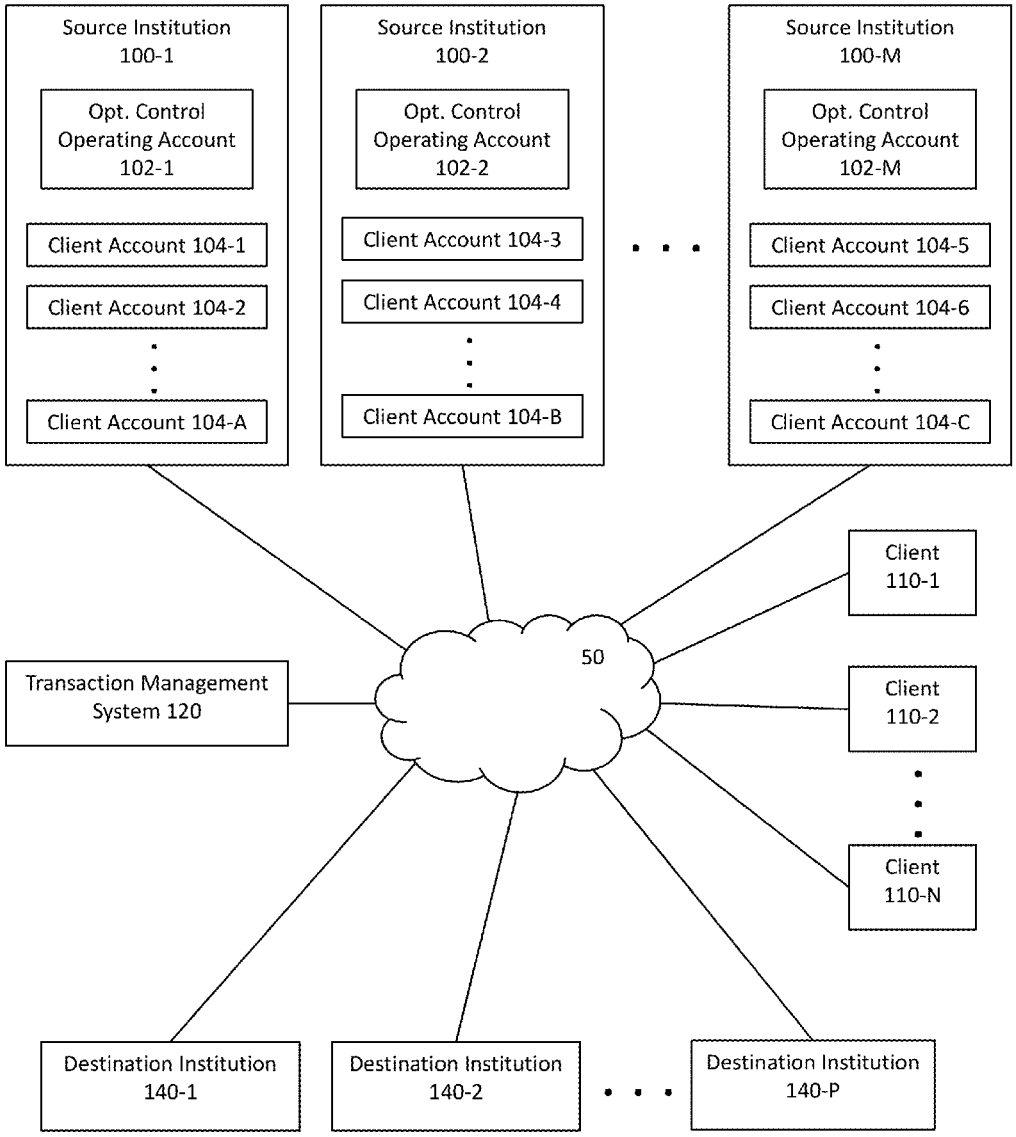

Source Institution
100-1
Opt. Control
Operating Account
102-1
Client Account 104-1
Client Account 104-2
Client Account 104-A
Source Institution
100-2
Opt. Control
Operating Account
102-2
Client Account 104-3
Client Account 104-4
Client Account 104-B
Source Institution
100-M
Opt. Control
Operating Account
102-M
Client Account 104-5
Client Account 104-6
Client Account 104-C
Client
110-1
Client
110-2
Client
110-N
50
Transaction Management
System 120
Deposit Institution
130-1
DDA 132-1
MMDA 134-1
Deposit Institution
130-2
DDA 132-2
MMDA 134-2
Deposit Institution
130-P
DDA 132-P
MMDA 134-P

FIG. 1A


Source Institution
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Opt. Control
Operating Account
102-1
Client Account 104-1
Client Account 104-2
Client Account 104-A
Source Institution
100-2
Opt. Control
Operating Account
102-2
Client Account 104-3
Client Account 104-4
Client Account 104-B
Source Institution
100-M
Opt. Control
Operating Account
102-M
Client Account 104-5
Client Account 104-6
Client Account 104-C
Client
110-1
Client
110-2
Client
110-N
50
Transaction Management
System 120
Destination Institution
140-1
Destination Institution
140-2
Destination Institution
140-P

FIG. 1B

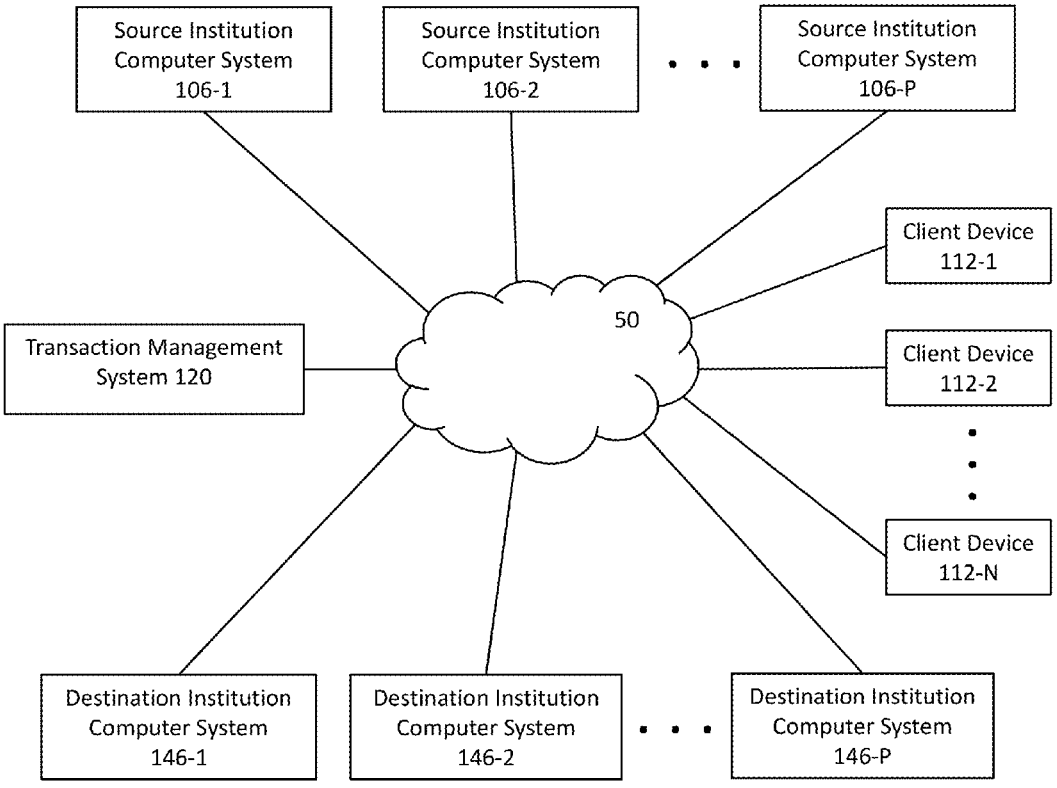
Source Institution Computer System 106-1
Source Institution Computer System 106-2
Source Institution Computer System 106-P
Client Device 112-1
Client Device 112-2
Client Device 112-N
50
Transaction Management System 120
Destination Institution Computer System 146-1
Destination Institution Computer System 146-2
Destination Institution Computer System 146-P

FIG. 1C

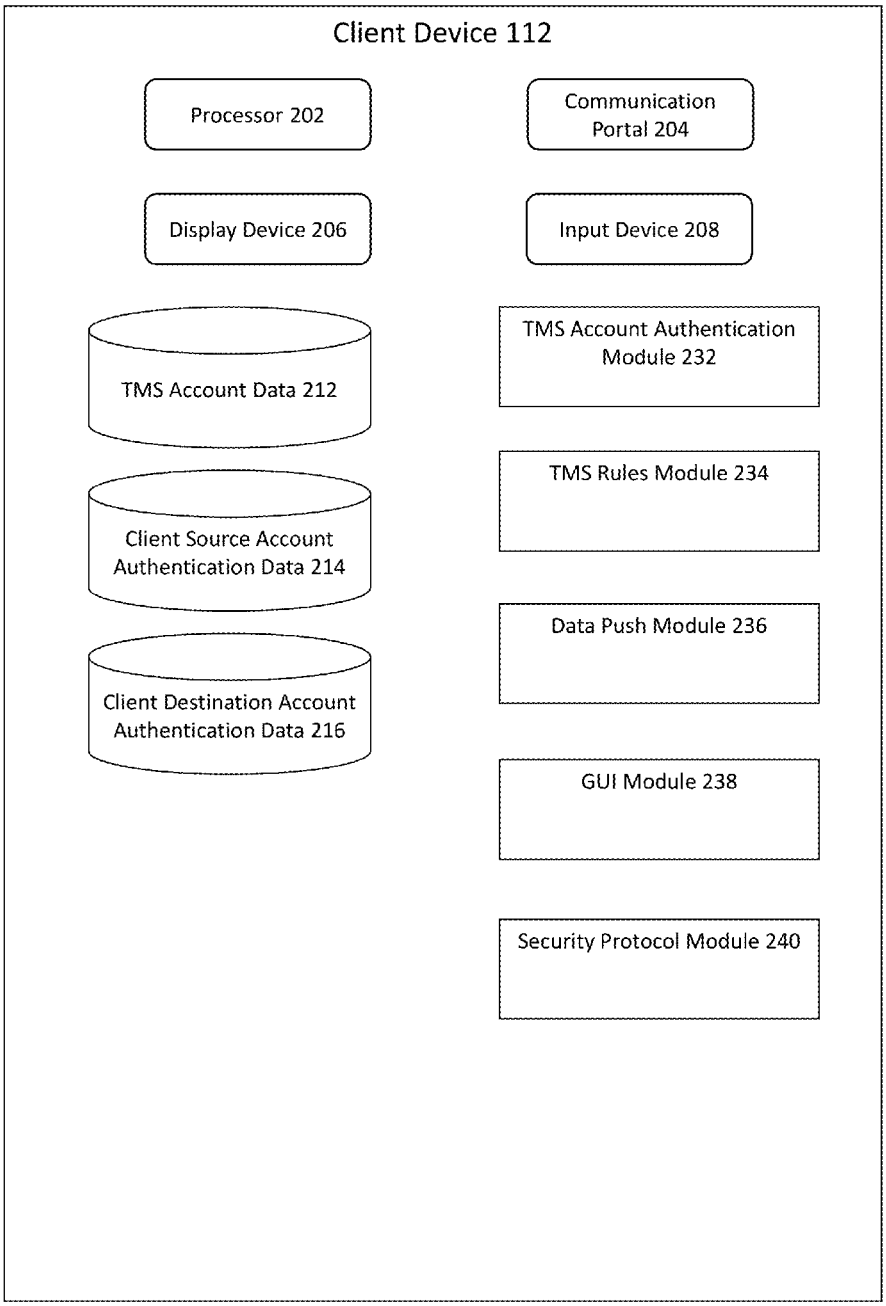
Client Device 112
Processor 202
Communication Portal 204
Display Device 206
Input Device 208
TMS Account Data 212
TMS Account Authentication Module 232
Client Source Account Authentication Data 214
TMS Rules Module 234
Client Destination Account Authentication Data 216
Data Push Module 236
GUI Module 238
Security Protocol Module 240

FIG. 2

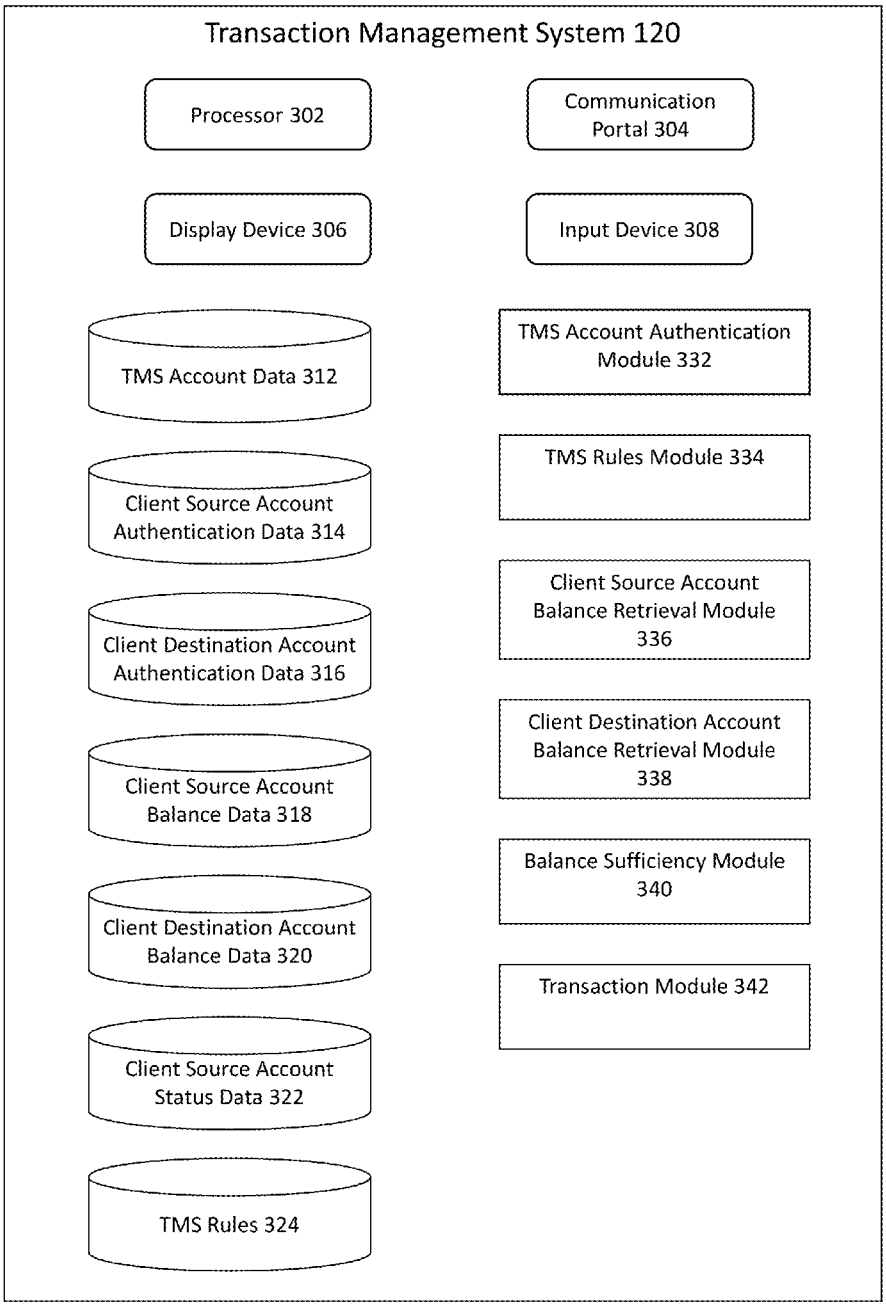
Transaction Management System 120
Processor 302
Communication Portal 304
Display Device 306
Input Device 308
TMS Account Data 312
TMS Account Authentication Module 332
TMS Rules Module 334
Client Source Account Authentication Data 314
Client Source Account Balance Retrieval Module 336
Client Destination Account Authentication Data 316
Client Destination Account Balance Retrieval Module 338
Client Source Account Balance Data 318
Balance Sufficiency Module 340
Client Destination Account Balance Data 320
Transaction Module 342
Client Source Account Status Data 322
TMS Rules 324

FIG. 3

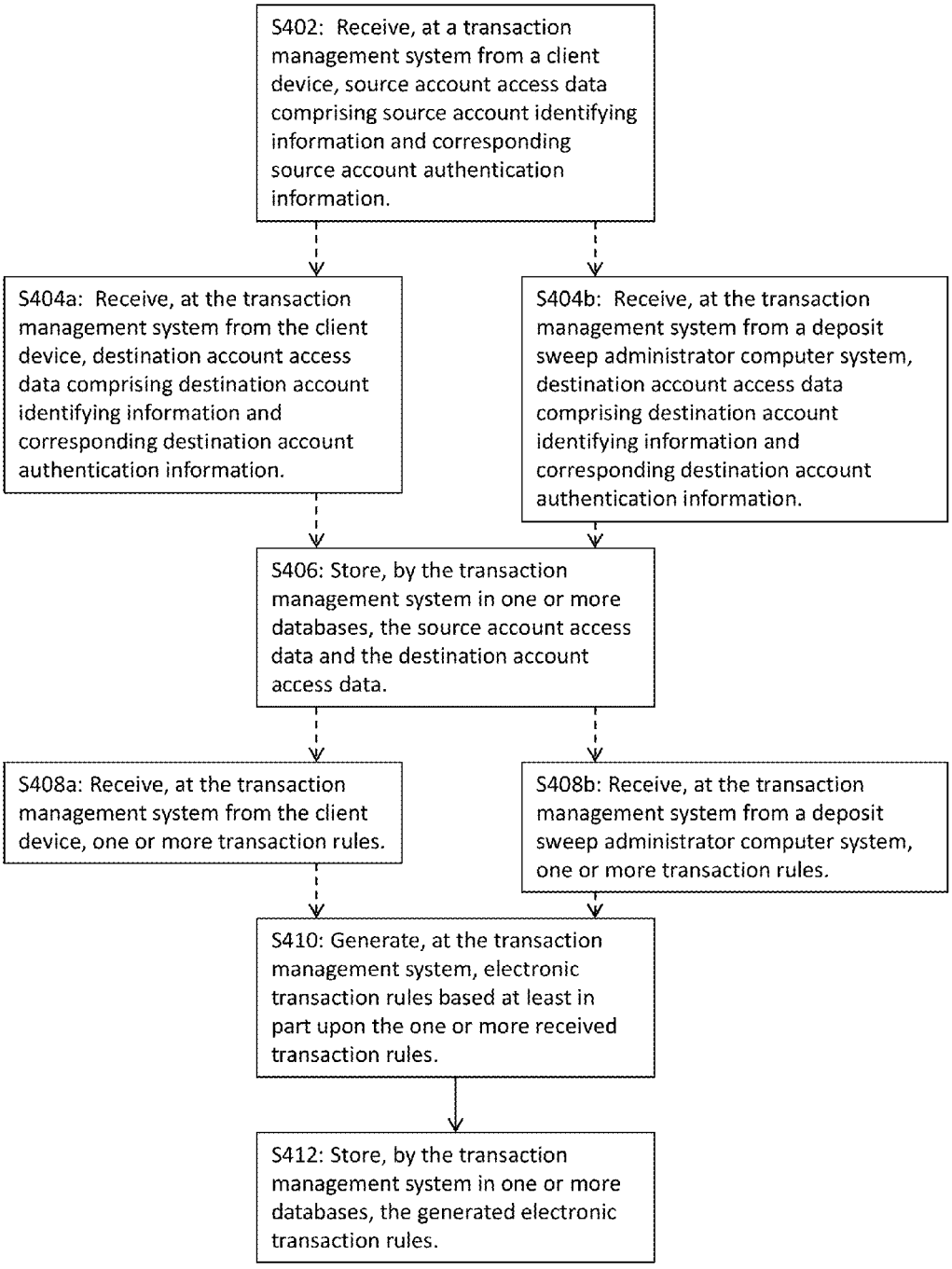
S402: Receive, at a transaction management system from a client device, source account access data comprising source account identifying information and corresponding source account authentication information.
S404a: Receive, at the transaction management system from the client device, destination account access data comprising destination account identifying information and corresponding destination account authentication information.
S404b: Receive, at the transaction management system from a deposit sweep administrator computer system, destination account access data comprising destination account identifying information and corresponding destination account authentication information.
S406: Store, by the transaction management system in one or more databases, the source account access data and the destination account access data.
S408a: Receive, at the transaction management system from the client device, one or more transaction rules.
S408b: Receive, at the transaction management system from a deposit sweep administrator computer system, one or more transaction rules.
S410: Generate, at the transaction management system, electronic transaction rules based at least in part upon the one or more received transaction rules.
S412: Store, by the transaction management system in one or more databases, the generated electronic transaction rules.

FIG. 4

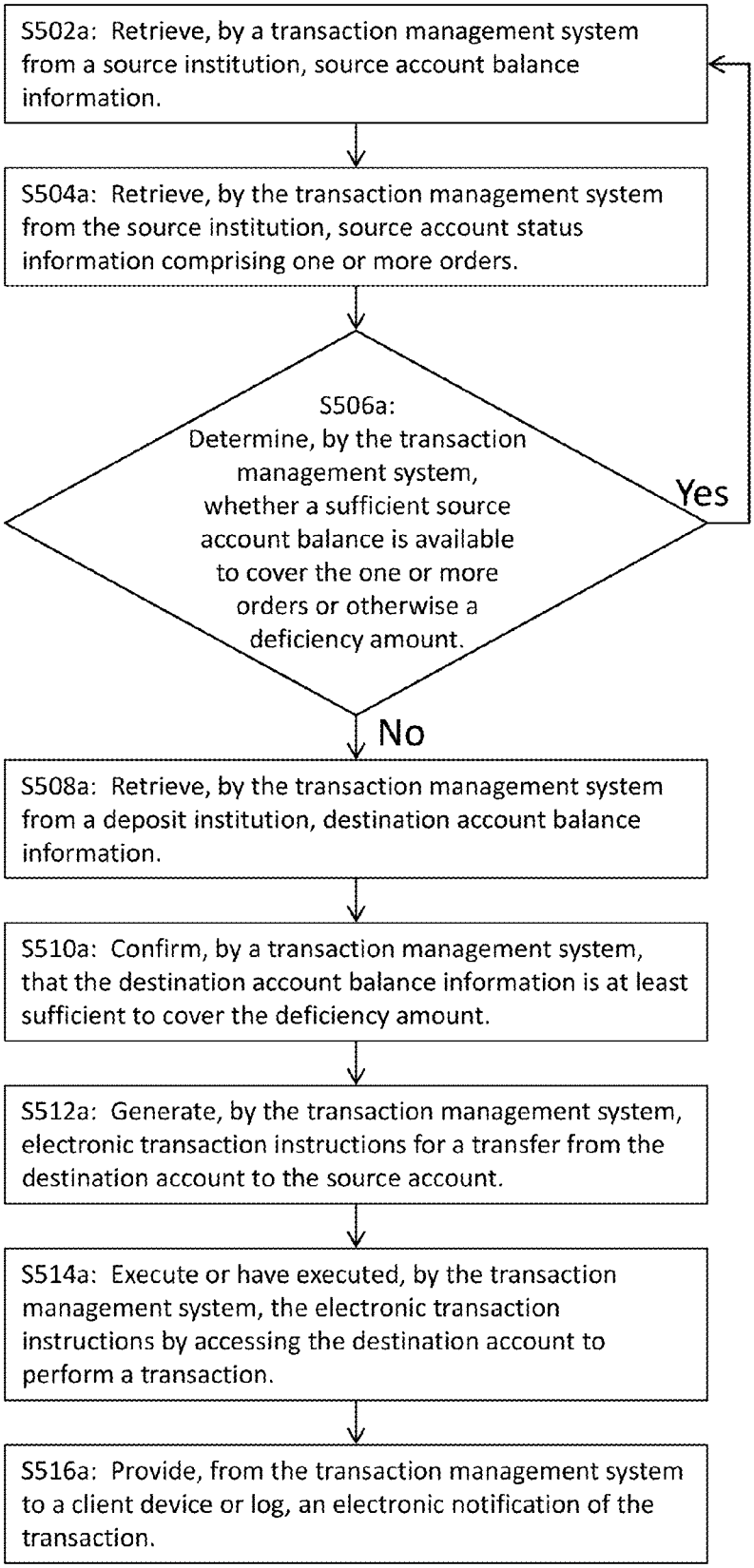
S502a: Retrieve, by a transaction management system from a source institution, source account balance information.
S504a: Retrieve, by the transaction management system from the source institution, source account status information comprising one or more orders.
S506a: Determine, by the transaction management system, whether a sufficient source account balance is available to cover the one or more orders or otherwise a deficiency amount.
Yes
No
S508a: Retrieve, by the transaction management system from a deposit institution, destination account balance information.
S510a: Confirm, by a transaction management system, that the destination account balance information is at least sufficient to cover the deficiency amount.
S512a: Generate, by the transaction management system, electronic transaction instructions for a transfer from the destination account to the source account.
S514a: Execute or have executed, by the transaction management system, the electronic transaction instructions by accessing the destination account to perform a transaction.
S516a: Provide, from the transaction management system to a client device or log, an electronic notification of the transaction.

FIG. 5A

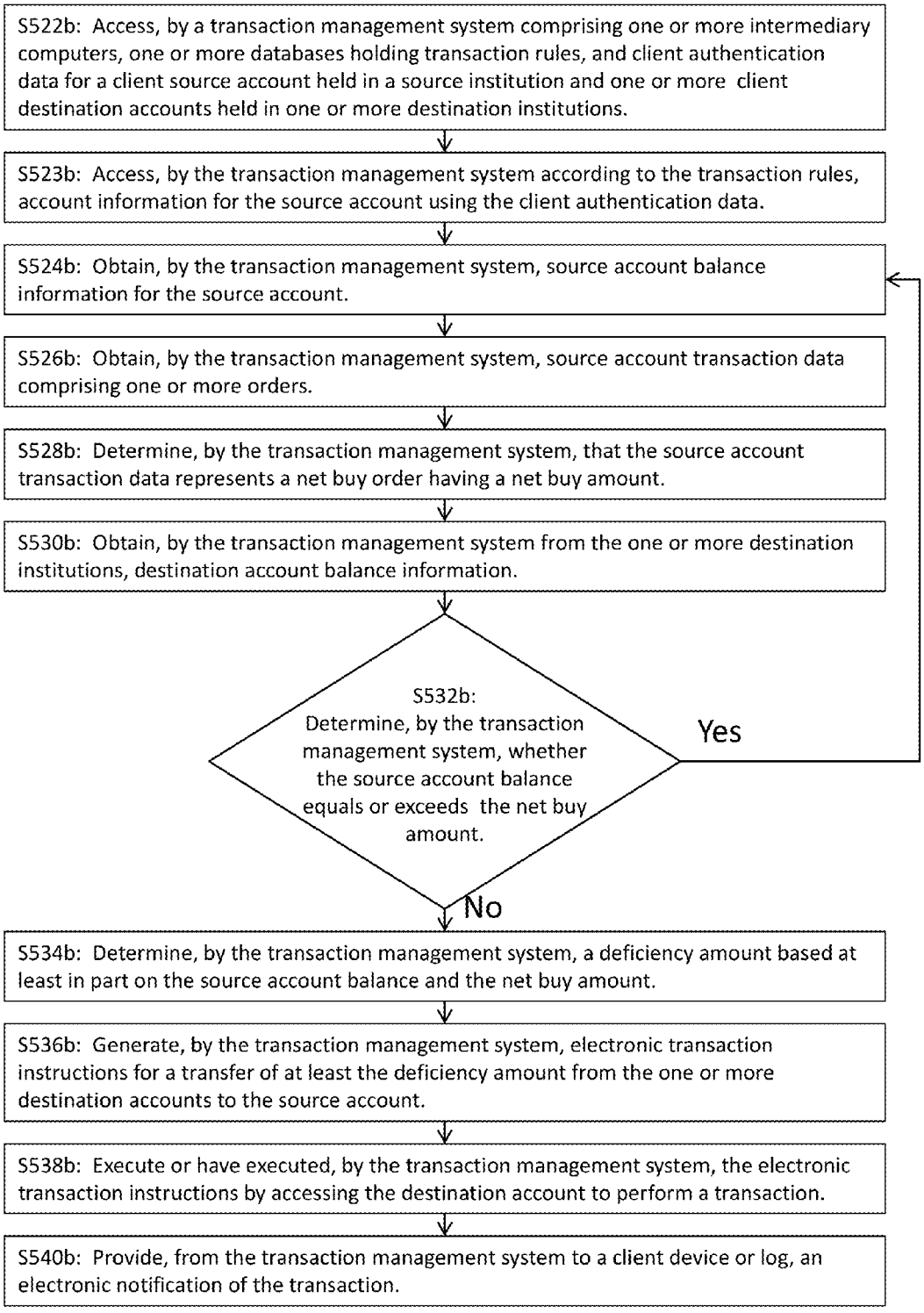
S522b: Access, by a transaction management system comprising one or more intermediary computers, one or more databases holding transaction rules, and client authentication data for a client source account held in a source institution and one or more client destination accounts held in one or more destination institutions.
S523b: Access, by the transaction management system according to the transaction rules, account information for the source account using the client authentication data.
S524b: Obtain, by the transaction management system, source account balance information for the source account.
S526b: Obtain, by the transaction management system, source account transaction data comprising one or more orders.
S528b: Determine, by the transaction management system, that the source account transaction data represents a net buy order having a net buy amount.
S530b: Obtain, by the transaction management system from the one or more destination institutions, destination account balance information.
S532b: Determine, by the transaction management system, whether the source account balance equals or exceeds the net buy amount.
Yes
No
S534b: Determine, by the transaction management system, a deficiency amount based at least in part on the source account balance and the net buy amount.
S536b: Generate, by the transaction management system, electronic transaction instructions for a transfer of at least the deficiency amount from the one or more destination accounts to the source account.
S538b: Execute or have executed, by the transaction management system, the electronic transaction instructions by accessing the destination account to perform a transaction.
S540b: Provide, from the transaction management system to a client device or log, an electronic notification of the transaction.

FIG. 5B

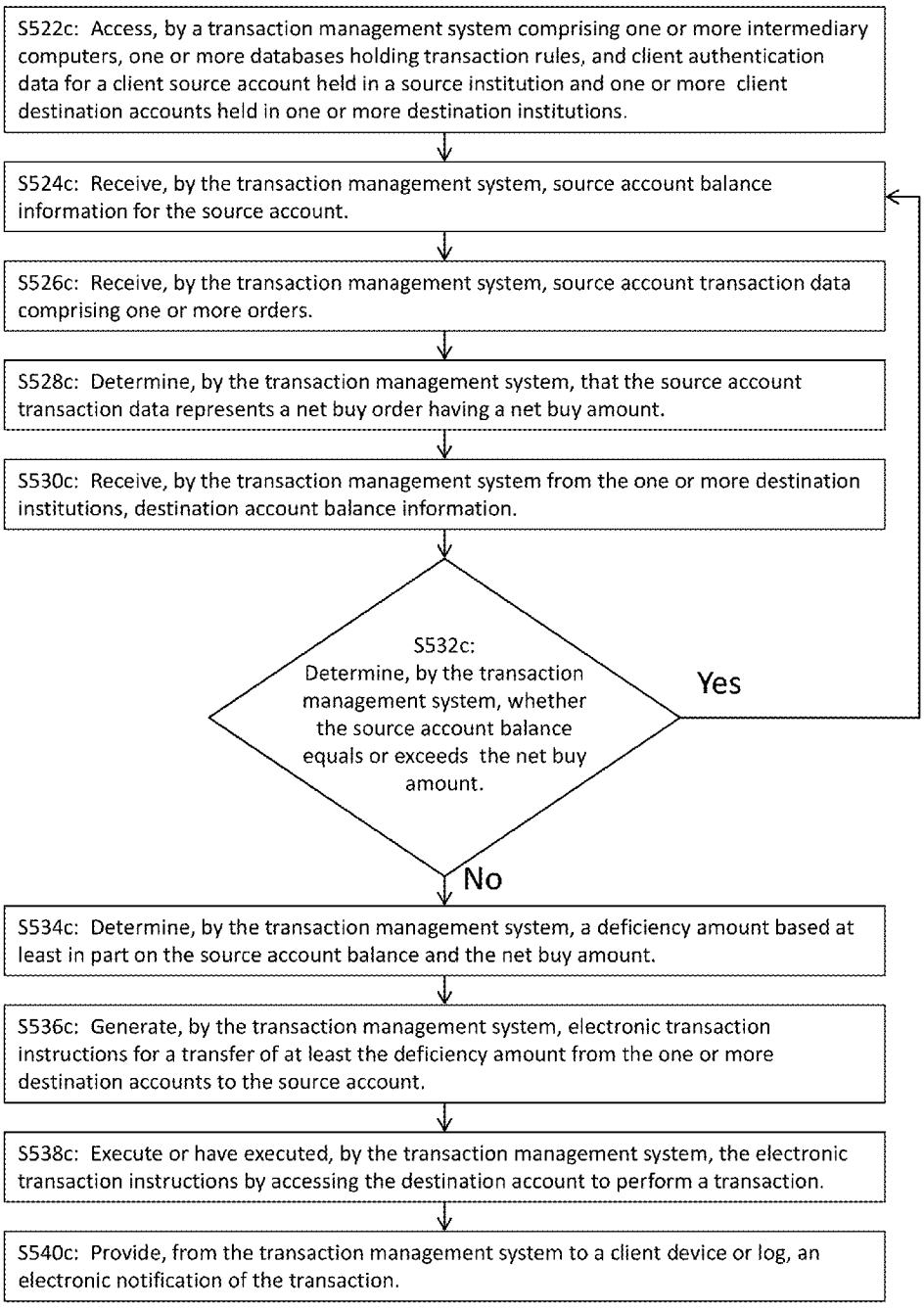
S522c: Access, by a transaction management system comprising one or more intermediary computers, one or more databases holding transaction rules, and client authentication data for a client source account held in a source institution and one or more client destination accounts held in one or more destination institutions.
S524c: Receive, by the transaction management system, source account balance information for the source account.
S526c: Receive, by the transaction management system, source account transaction data comprising one or more orders.
S528c: Determine, by the transaction management system, that the source account transaction data represents a net buy order having a net buy amount.
S530c: Receive, by the transaction management system from the one or more destination institutions, destination account balance information.
S532c: Determine, by the transaction management system, whether the source account balance equals or exceeds the net buy amount.
Yes
No
S534c: Determine, by the transaction management system, a deficiency amount based at least in part on the source account balance and the net buy amount.
S536c: Generate, by the transaction management system, electronic transaction instructions for a transfer of at least the deficiency amount from the one or more destination accounts to the source account.
S538c: Execute or have executed, by the transaction management system, the electronic transaction instructions by accessing the destination account to perform a transaction.
S540c: Provide, from the transaction management system to a client device or log, an electronic notification of the transaction.

FIG. 5C

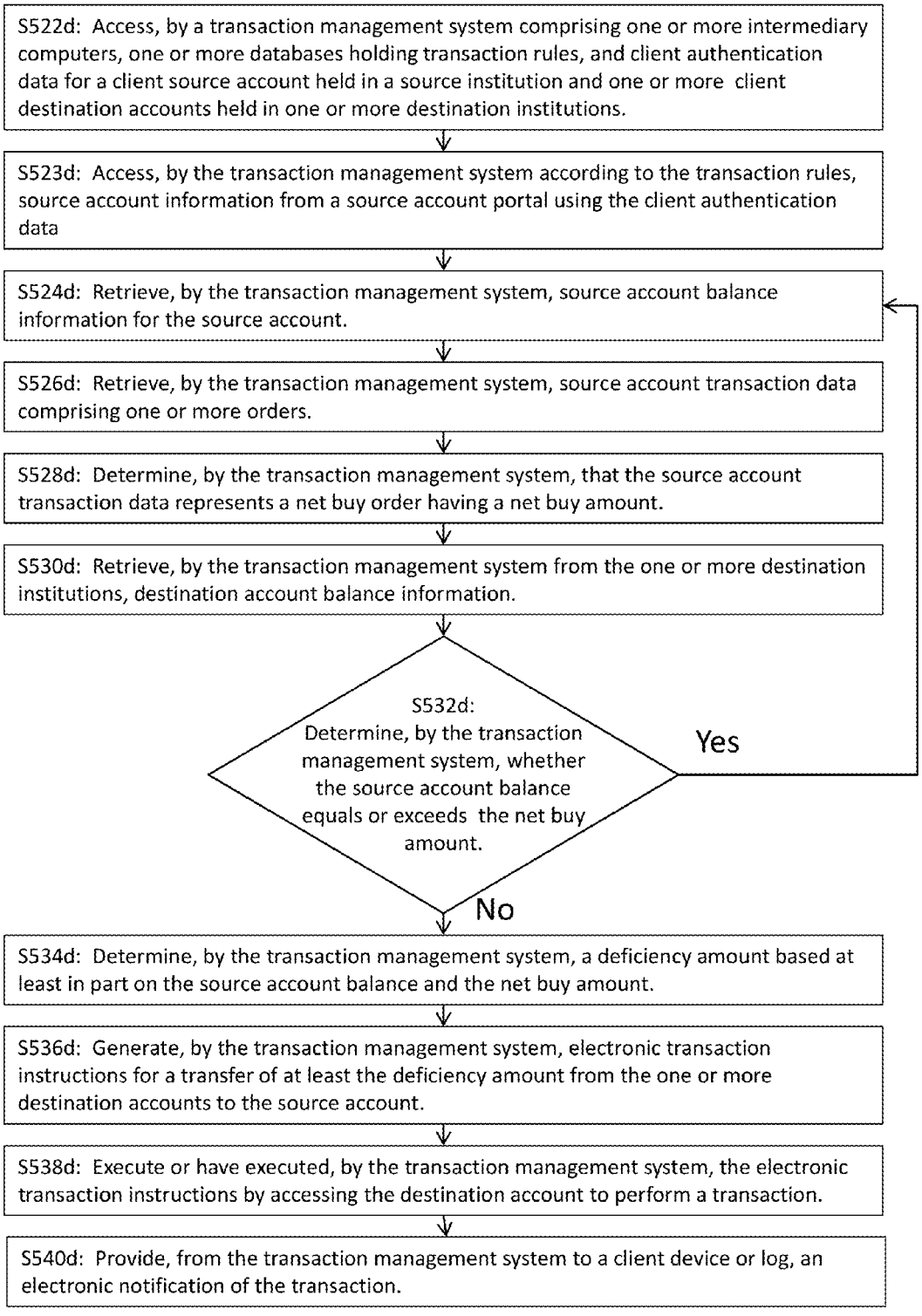
S522d: Access, by a transaction management system comprising one or more intermediary computers, one or more databases holding transaction rules, and client authentication data for a client source account held in a source institution and one or more client destination accounts held in one or more destination institutions.
S523d: Access, by the transaction management system according to the transaction rules, source account information from a source account portal using the client authentication data
S524d: Retrieve, by the transaction management system, source account balance information for the source account.
S526d: Retrieve, by the transaction management system, source account transaction data comprising one or more orders.
S528d: Determine, by the transaction management system, that the source account transaction data represents a net buy order having a net buy amount.
S530d: Retrieve, by the transaction management system from the one or more destination institutions, destination account balance information.
S532d: Determine, by the transaction management system, whether the source account balance equals or exceeds the net buy amount.
Yes
No
S534d: Determine, by the transaction management system, a deficiency amount based at least in part on the source account balance and the net buy amount.
S536d: Generate, by the transaction management system, electronic transaction instructions for a transfer of at least the deficiency amount from the one or more destination accounts to the source account.
S538d: Execute or have executed, by the transaction management system, the electronic transaction instructions by accessing the destination account to perform a transaction.
S540d: Provide, from the transaction management system to a client device or log, an electronic notification of the transaction.

FIG. 5D

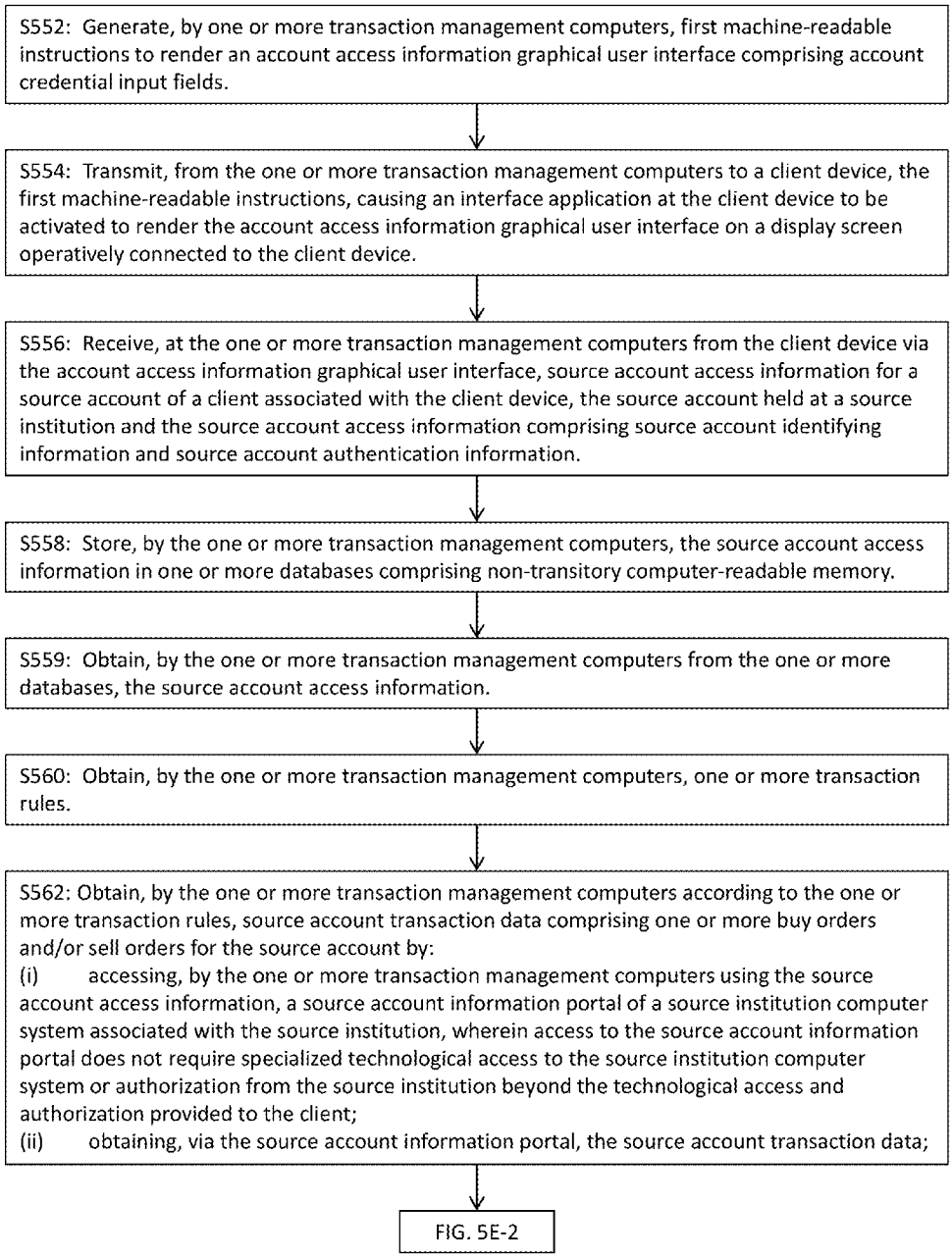
S552: Generate, by one or more transaction management computers, first machine-readable instructions to render an account access information graphical user interface comprising account credential input fields.
S554: Transmit, from the one or more transaction management computers to a client device, the first machine-readable instructions, causing an interface application at the client device to be activated to render the account access information graphical user interface on a display screen operatively connected to the client device.
S556: Receive, at the one or more transaction management computers from the client device via the account access information graphical user interface, source account access information for a source account of a client associated with the client device, the source account held at a source institution and the source account access information comprising source account identifying information and source account authentication information.
S558: Store, by the one or more transaction management computers, the source account access information in one or more databases comprising non-transitory computer-readable memory.
S559: Obtain, by the one or more transaction management computers from the one or more databases, the source account access information.
S560: Obtain, by the one or more transaction management computers, one or more transaction rules.
S562: Obtain, by the one or more transaction management computers according to the one or more transaction rules, source account transaction data comprising one or more buy orders and/or sell orders for the source account by:
(i) accessing, by the one or more transaction management computers using the source account access information, a source account information portal of a source institution computer system associated with the source institution, wherein access to the source account information portal does not require specialized technological access to the source institution computer system or authorization from the source institution beyond the technological access and authorization provided to the client;
(ii) obtaining, via the source account information portal, the source account transaction data;
FIG. 5E-2

FIG. 5E-1

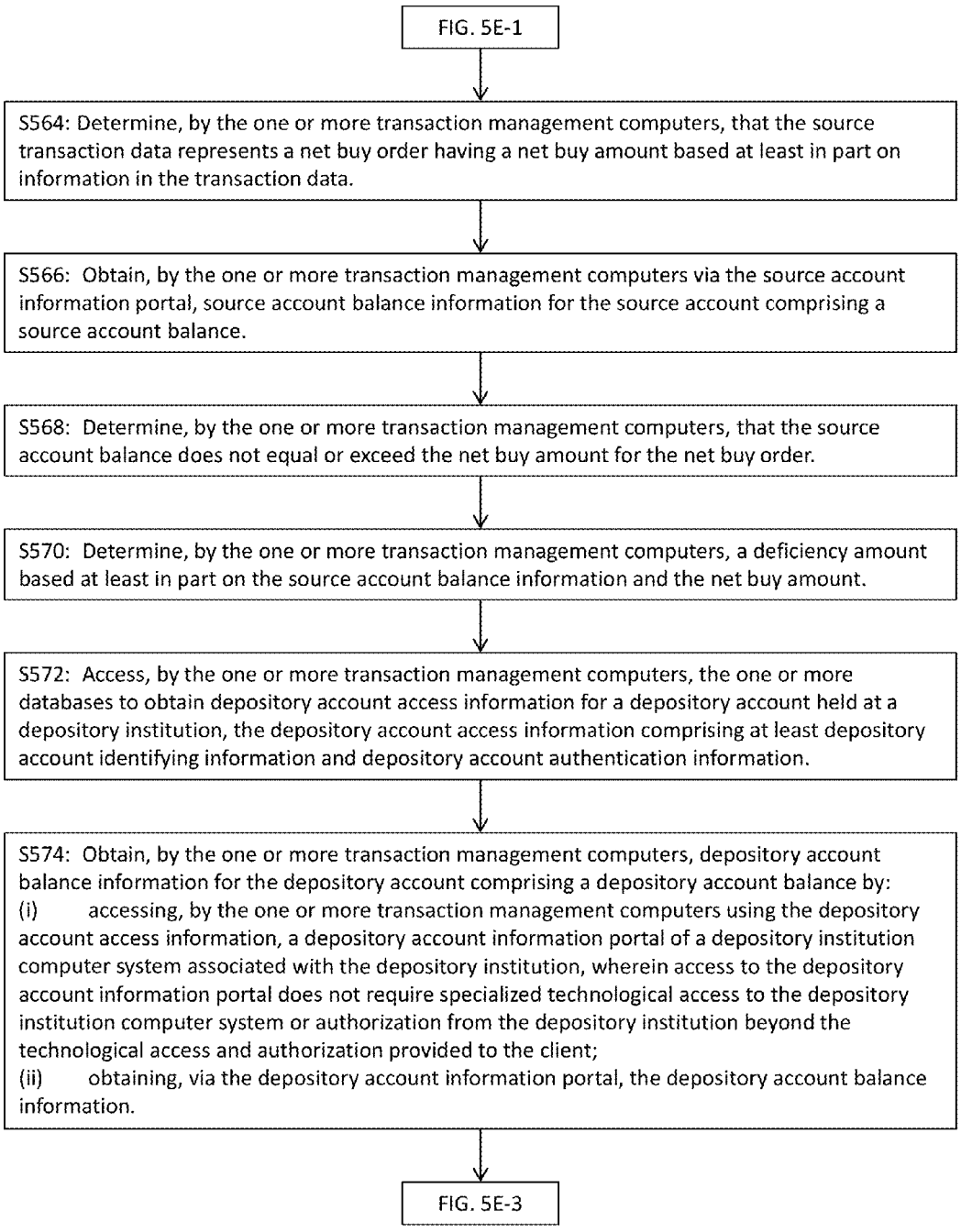
FIG. 5E-1
S564: Determine, by the one or more transaction management computers, that the source transaction data represents a net buy order having a net buy amount based at least in part on information in the transaction data.
S566: Obtain, by the one or more transaction management computers via the source account information portal, source account balance information for the source account comprising a source account balance.
S568: Determine, by the one or more transaction management computers, that the source account balance does not equal or exceed the net buy amount for the net buy order.
S570: Determine, by the one or more transaction management computers, a deficiency amount based at least in part on the source account balance information and the net buy amount.
S572: Access, by the one or more transaction management computers, the one or more databases to obtain depository account access information for a depository account held at a depository institution, the depository account access information comprising at least depository account identifying information and depository account authentication information.
S574: Obtain, by the one or more transaction management computers, depository account balance information for the depository account comprising a depository account balance by:
(i) accessing, by the one or more transaction management computers using the depository account access information, a depository account information portal of a depository institution computer system associated with the depository institution, wherein access to the depository account information portal does not require specialized technological access to the depository institution computer system or authorization from the depository institution beyond the technological access and authorization provided to the client;
(ii) obtaining, via the depository account information portal, the depository account balance information.
FIG. 5E-3

FIG. 5E-2

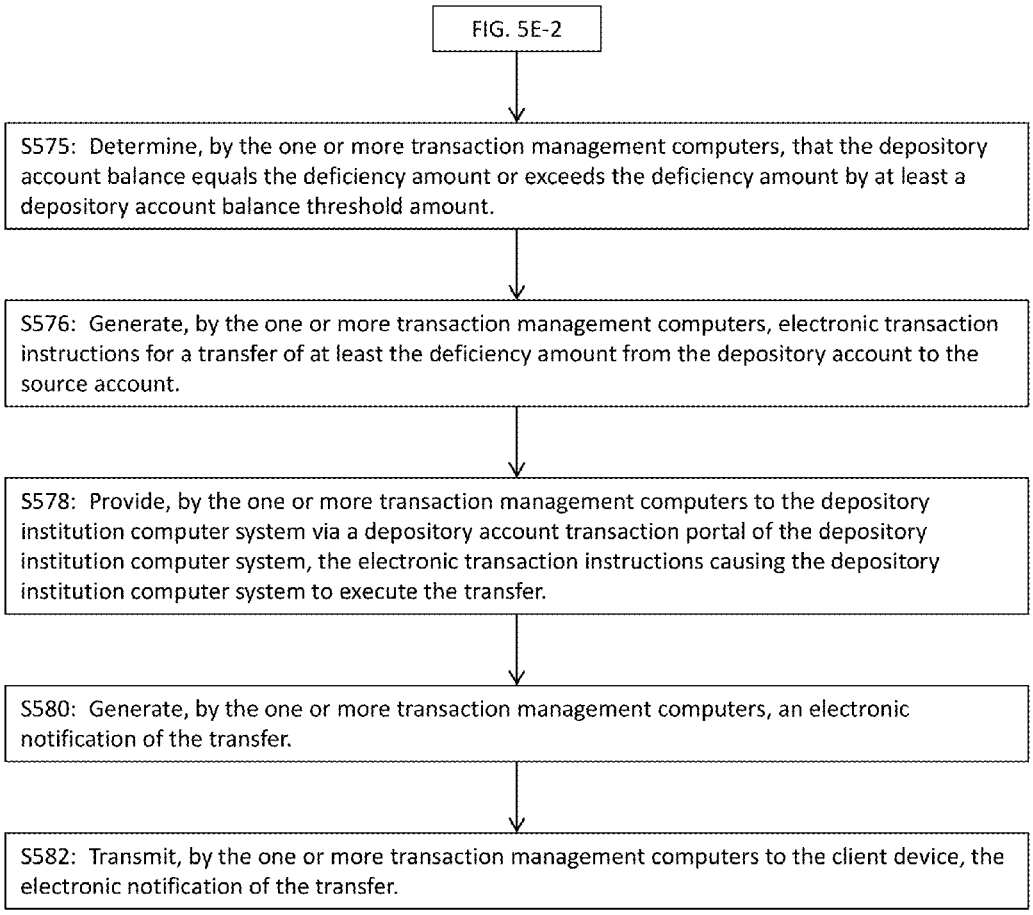
FIG. 5E-2
S575: Determine, by the one or more transaction management computers, that the depository account balance equals the deficiency amount or exceeds the deficiency amount by at least a depository account balance threshold amount.
S576: Generate, by the one or more transaction management computers, electronic transaction instructions for a transfer of at least the deficiency amount from the depository account to the source account.
S578: Provide, by the one or more transaction management computers to the depository institution computer system via a depository account transaction portal of the depository institution computer system, the electronic transaction instructions causing the depository institution computer system to execute the transfer.
S580: Generate, by the one or more transaction management computers, an electronic notification of the transfer.
S582: Transmit, by the one or more transaction management computers to the client device, the electronic notification of the transfer.

FIG. 5E-3

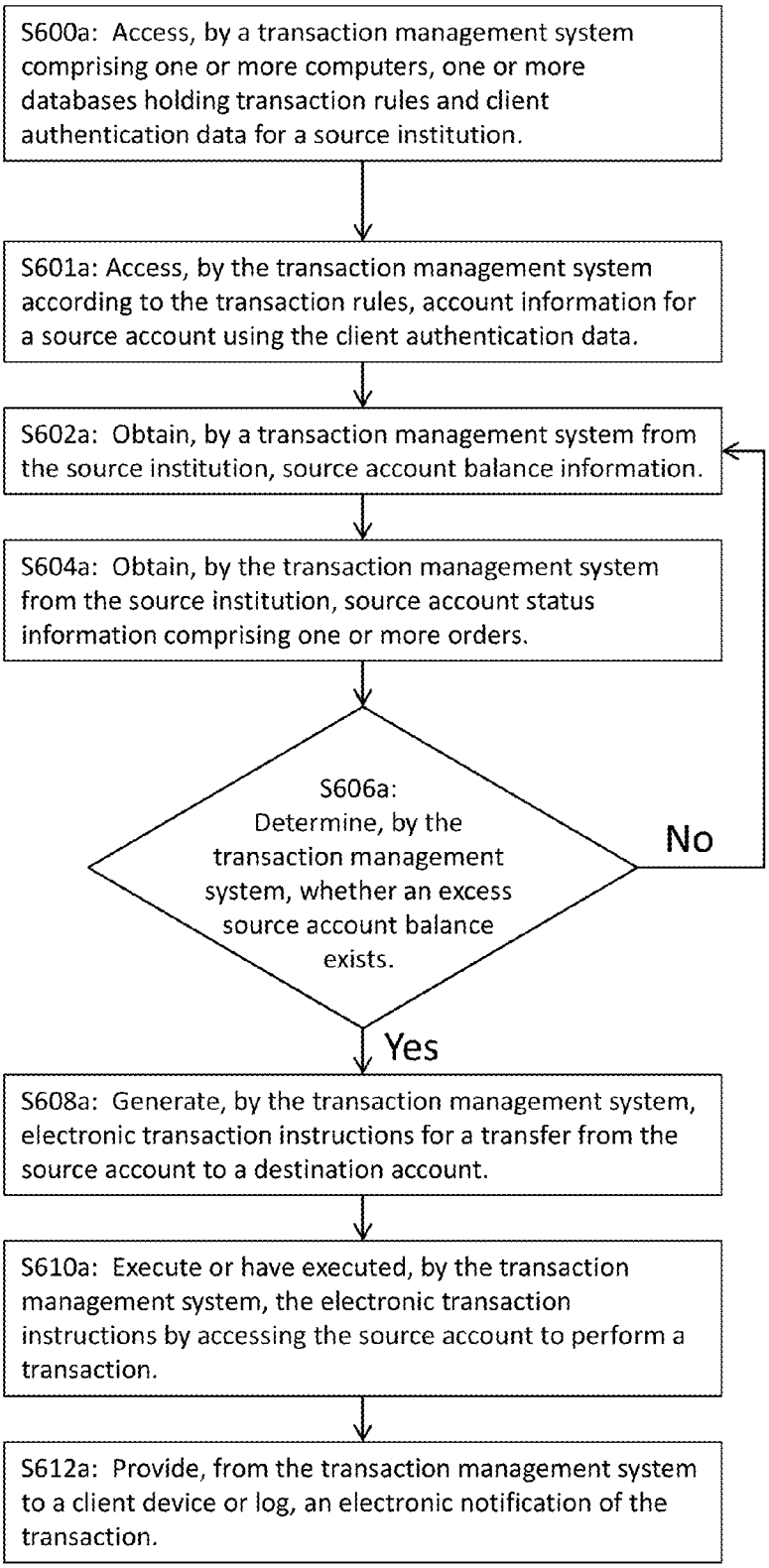
S600a: Access, by a transaction management system comprising one or more computers, one or more databases holding transaction rules and client authentication data for a source institution.
S601a: Access, by the transaction management system according to the transaction rules, account information for a source account using the client authentication data.
S602a: Obtain, by a transaction management system from the source institution, source account balance information.
S604a: Obtain, by the transaction management system from the source institution, source account status information comprising one or more orders.
S606a: Determine, by the transaction management system, whether an excess source account balance exists.
No
Yes
S608a: Generate, by the transaction management system, electronic transaction instructions for a transfer from the source account to a destination account.
S610a: Execute or have executed, by the transaction management system, the electronic transaction instructions by accessing the source account to perform a transaction.
S612a: Provide, from the transaction management system to a client device or log, an electronic notification of the transaction.

FIG. 6A

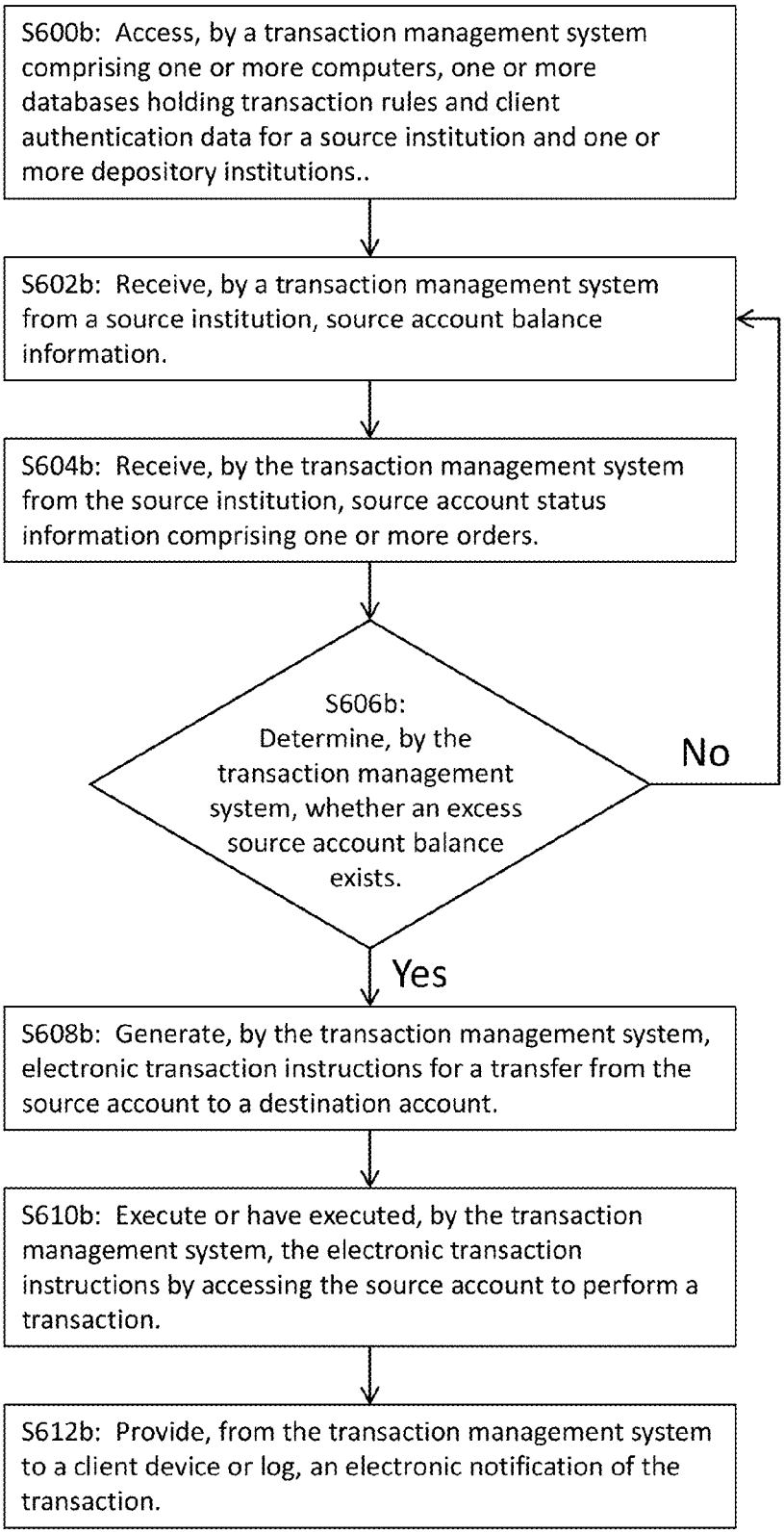
S600b: Access, by a transaction management system comprising one or more computers, one or more databases holding transaction rules and client authentication data for a source institution and one or more depository institutions..
S602b: Receive, by a transaction management system from a source institution, source account balance information.
S604b: Receive, by the transaction management system from the source institution, source account status information comprising one or more orders.
S606b: Determine, by the transaction management system, whether an excess source account balance exists.
No
Yes
S608b: Generate, by the transaction management system, electronic transaction instructions for a transfer from the source account to a destination account.
S610b: Execute or have executed, by the transaction management system, the electronic transaction instructions by accessing the source account to perform a transaction.
S612b: Provide, from the transaction management system to a client device or log, an electronic notification of the transaction.

FIG. 6B

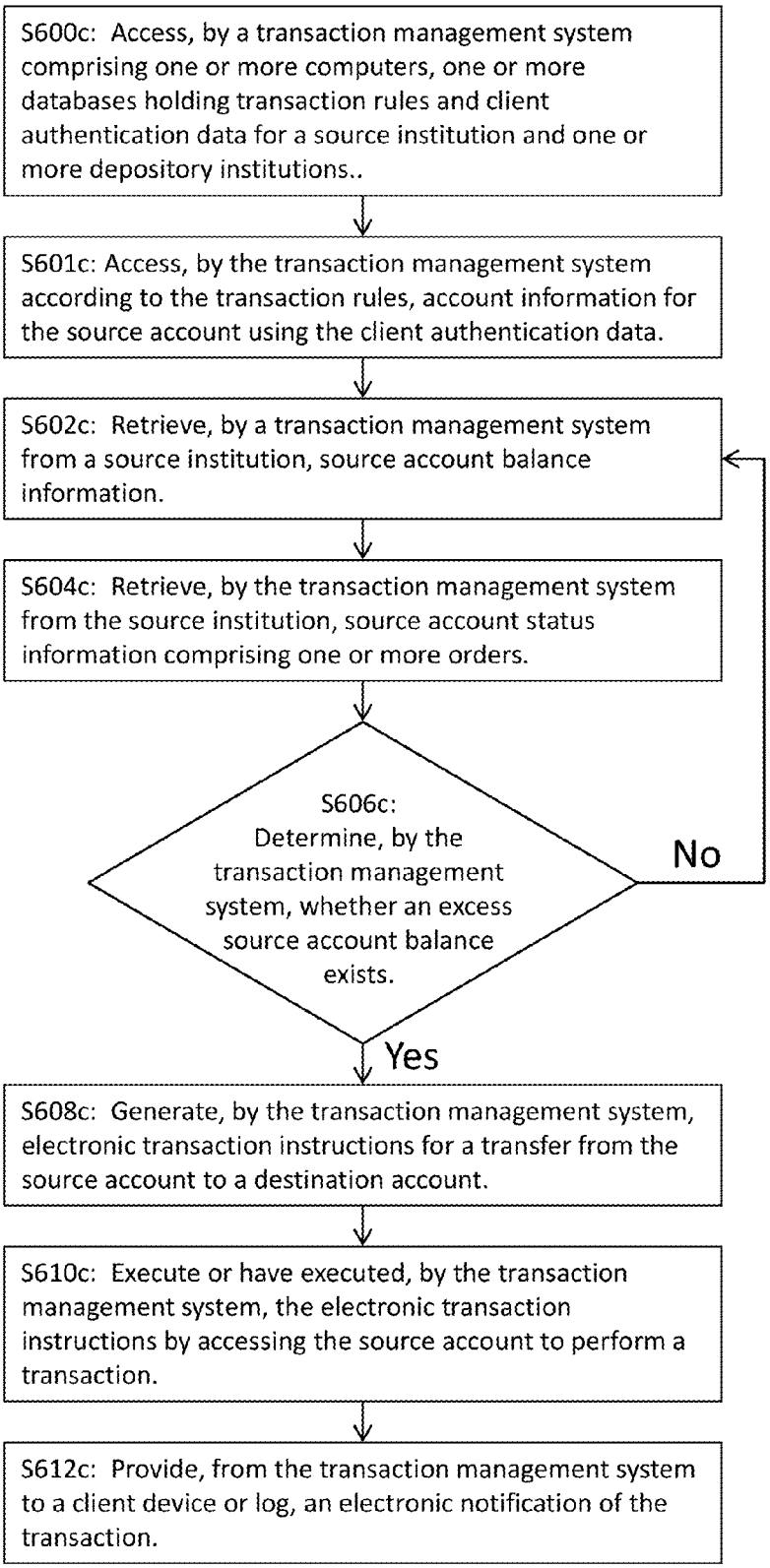
S600c: Access, by a transaction management system comprising one or more computers, one or more databases holding transaction rules and client authentication data for a source institution and one or more depository institutions..
S601c: Access, by the transaction management system according to the transaction rules, account information for the source account using the client authentication data.
S602c: Retrieve, by a transaction management system from a source institution, source account balance information.
S604c: Retrieve, by the transaction management system from the source institution, source account status information comprising one or more orders.
S606c: Determine, by the transaction management system, whether an excess source account balance exists.
No
Yes
S608c: Generate, by the transaction management system, electronic transaction instructions for a transfer from the source account to a destination account.
S610c: Execute or have executed, by the transaction management system, the electronic transaction instructions by accessing the source account to perform a transaction.
S612c: Provide, from the transaction management system to a client device or log, an electronic notification of the transaction.

FIG. 6C

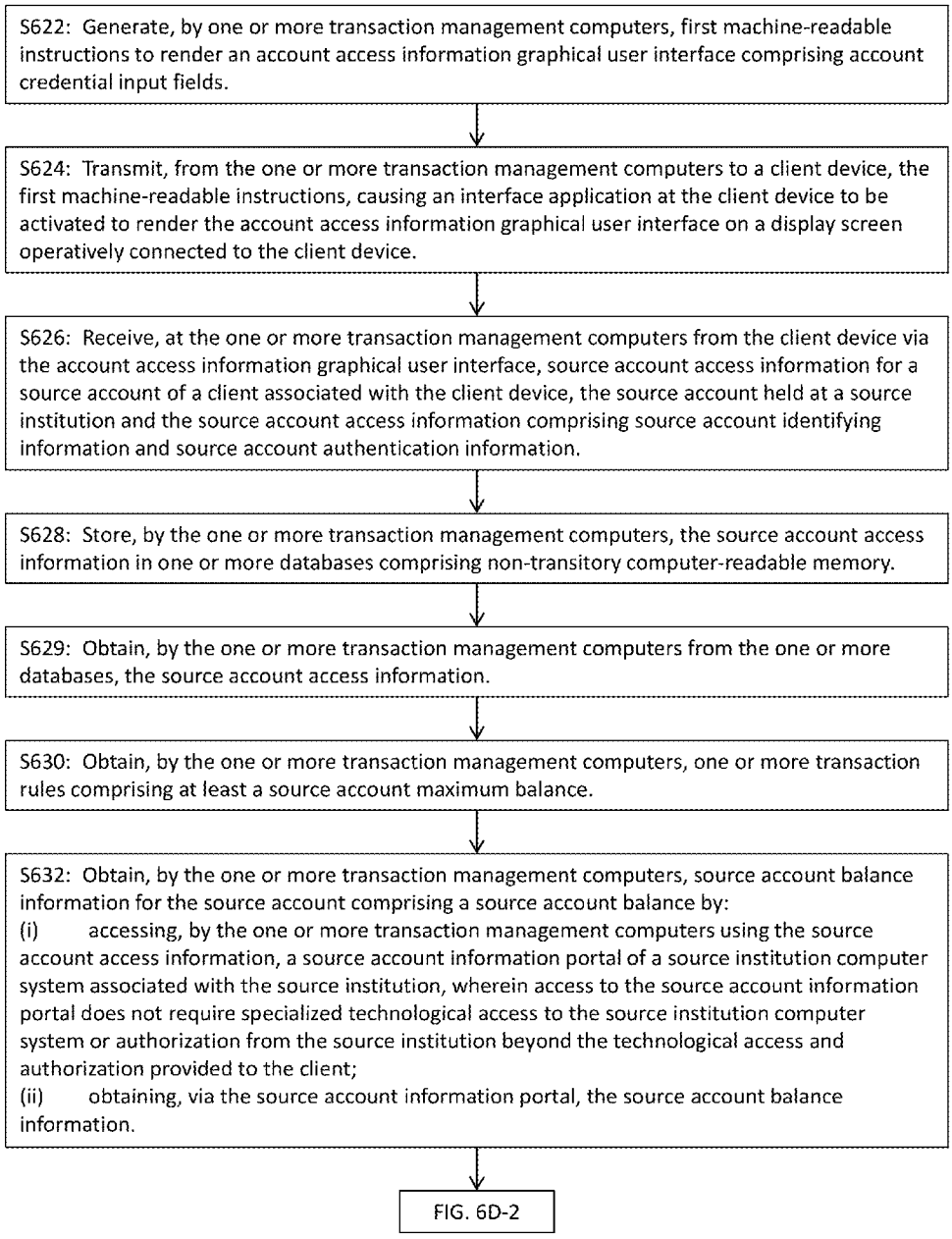
S622: Generate, by one or more transaction management computers, first machine-readable instructions to render an account access information graphical user interface comprising account credential input fields.
S624: Transmit, from the one or more transaction management computers to a client device, the first machine-readable instructions, causing an interface application at the client device to be activated to render the account access information graphical user interface on a display screen operatively connected to the client device.
S626: Receive, at the one or more transaction management computers from the client device via the account access information graphical user interface, source account access information for a source account of a client associated with the client device, the source account held at a source institution and the source account access information comprising source account identifying information and source account authentication information.
S628: Store, by the one or more transaction management computers, the source account access information in one or more databases comprising non-transitory computer-readable memory.
S629: Obtain, by the one or more transaction management computers from the one or more databases, the source account access information.
S630: Obtain, by the one or more transaction management computers, one or more transaction rules comprising at least a source account maximum balance.
S632: Obtain, by the one or more transaction management computers, source account balance information for the source account comprising a source account balance by:
(i) accessing, by the one or more transaction management computers using the source account access information, a source account information portal of a source institution computer system associated with the source institution, wherein access to the source account information portal does not require specialized technological access to the source institution computer system or authorization from the source institution beyond the technological access and authorization provided to the client;
(ii) obtaining, via the source account information portal, the source account balance information.
FIG. 6D-2

FIG. 6D-1

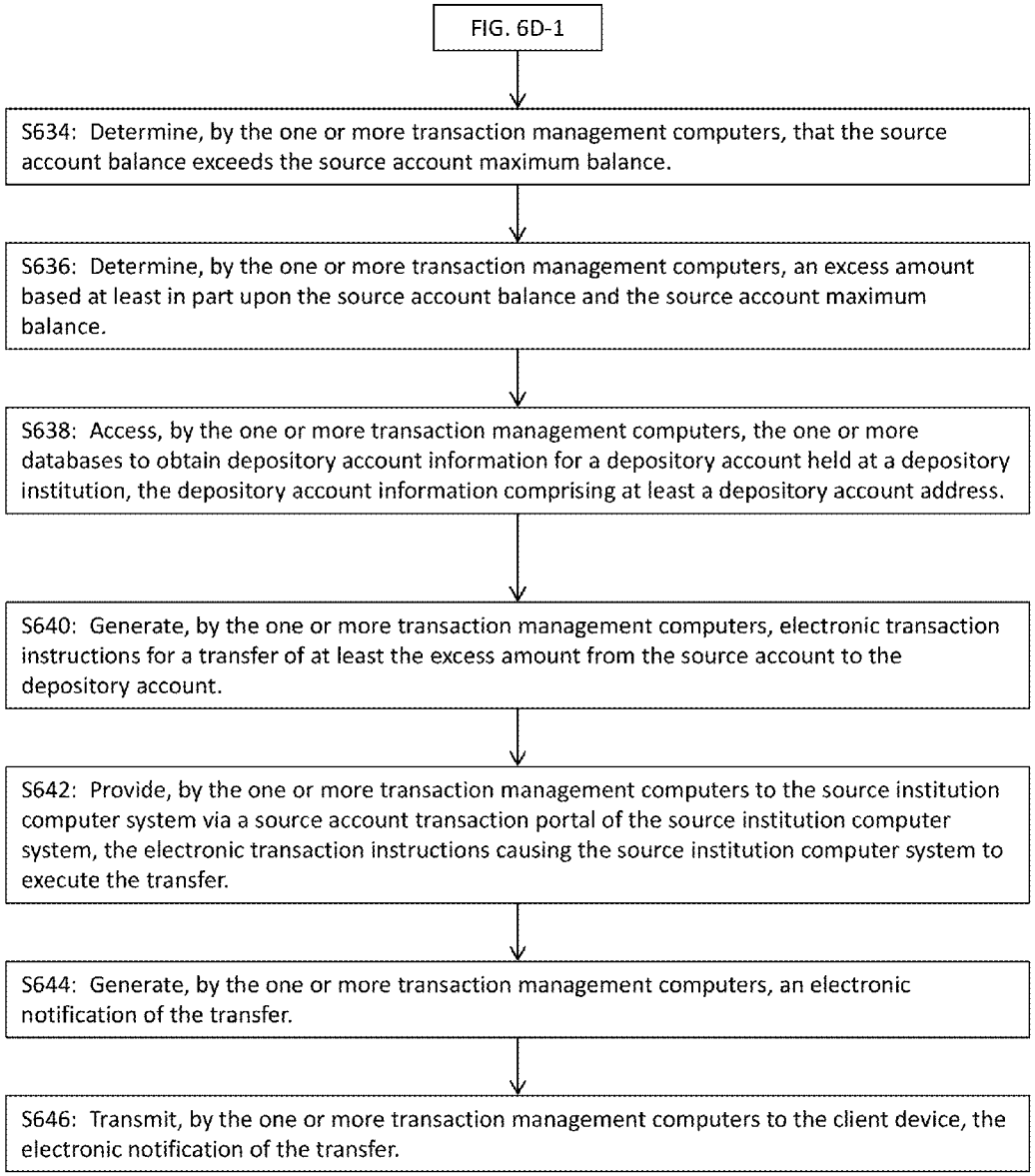
FIG. 6D-1
S634: Determine, by the one or more transaction management computers, that the source account balance exceeds the source account maximum balance.
S636: Determine, by the one or more transaction management computers, an excess amount based at least in part upon the source account balance and the source account maximum balance.
S638: Access, by the one or more transaction management computers, the one or more databases to obtain depository account information for a depository account held at a depository institution, the depository account information comprising at least a depository account address.
S640: Generate, by the one or more transaction management computers, electronic transaction instructions for a transfer of at least the excess amount from the source account to the depository account.
S642: Provide, by the one or more transaction management computers to the source institution computer system via a source account transaction portal of the source institution computer system, the electronic transaction instructions causing the source institution computer system to execute the transfer.
S644: Generate, by the one or more transaction management computers, an electronic notification of the transfer.
S646: Transmit, by the one or more transaction management computers to the client device, the electronic notification of the transfer.

FIG. 6D-2

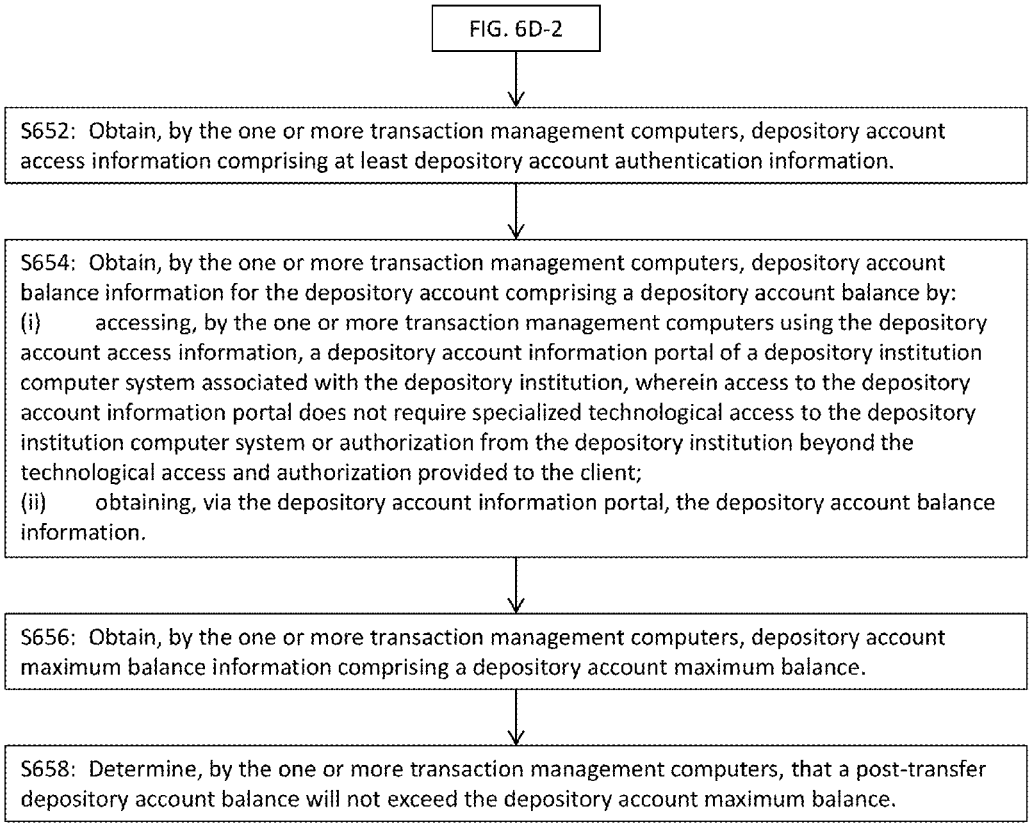
FIG. 6D-2
S652: Obtain, by the one or more transaction management computers, depository account access information comprising at least depository account authentication information.
S654: Obtain, by the one or more transaction management computers, depository account balance information for the depository account comprising a depository account balance by:
(i) accessing, by the one or more transaction management computers using the depository account access information, a depository account information portal of a depository institution computer system associated with the depository institution, wherein access to the depository account information portal does not require specialized technological access to the depository institution computer system or authorization from the depository institution beyond the technological access and authorization provided to the client;
(ii) obtaining, via the depository account information portal, the depository account balance information.
S656: Obtain, by the one or more transaction management computers, depository account maximum balance information comprising a depository account maximum balance.
S658: Determine, by the one or more transaction management computers, that a post-transfer depository account balance will not exceed the depository account maximum balance.

FIG. 6E

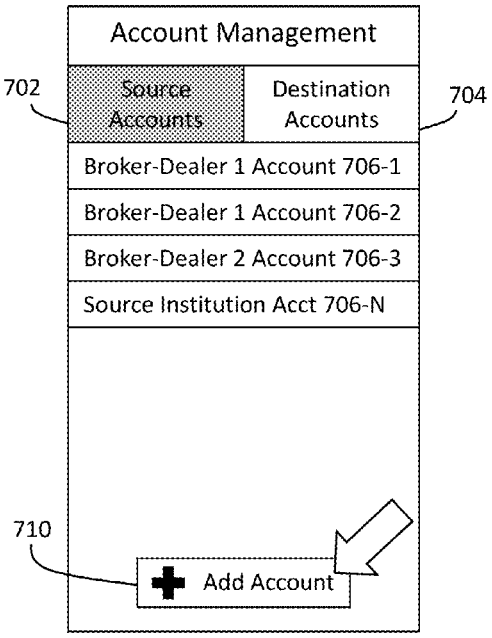

FIG. 7A

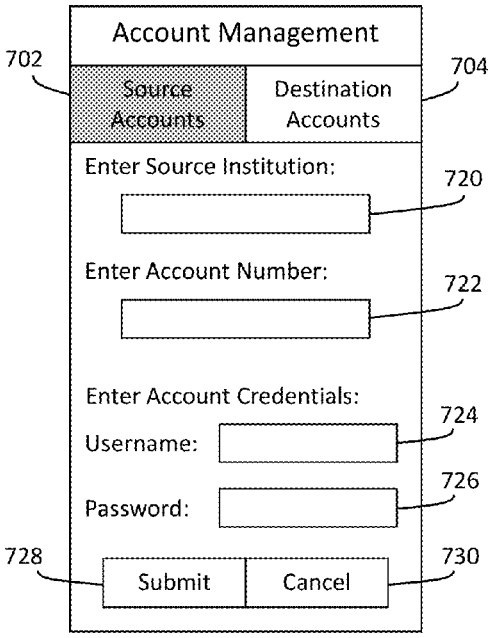

FIG. 7B

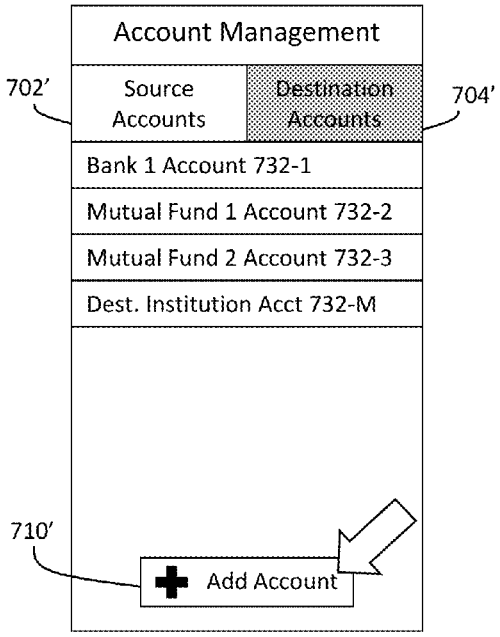

FIG. 7C

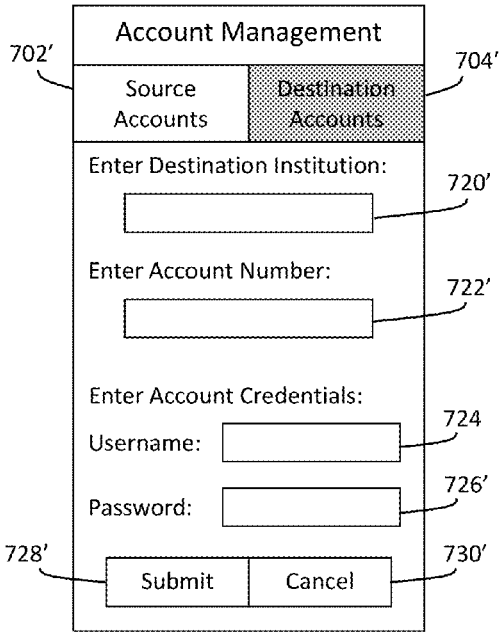

FIG. 7D

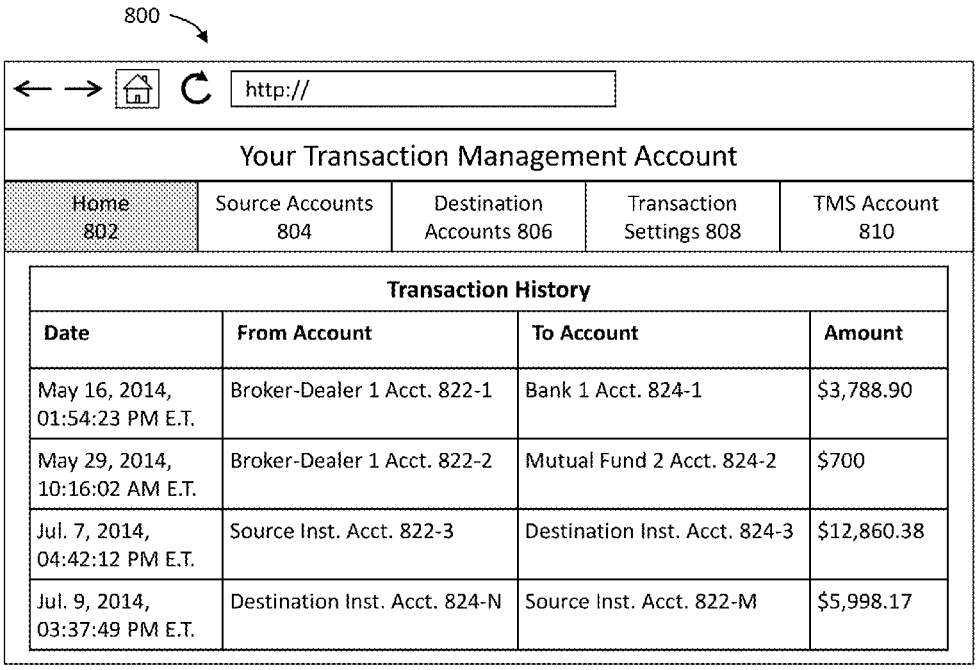
800
http://
Your Transaction Management Account
Home 802
Source Accounts 804
Destination Accounts 806
Transaction Settings 808
TMS Account 810
Transaction History
Date
From Account
To Account
Amount
May 16, 2014, 01:54:23 PM E.T.
Broker-Dealer 1 Acct. 822-1
Bank 1 Acct. 824-1
$3,788.90
May 29, 2014, 10:16:02 AM E.T.
Broker-Dealer 1 Acct. 822-2
Mutual Fund 2 Acct. 824-2
$700
Jul. 7, 2014, 04:42:12 PM E.T.
Source Inst. Acct. 822-3
Destination Inst. Acct. 824-3
$12,860.38
Jul. 9, 2014, 03:37:49 PM E.T.
Destination Inst. Acct. 824-N
Source Inst. Acct. 822-M
$5,998.17

FIG. 8A

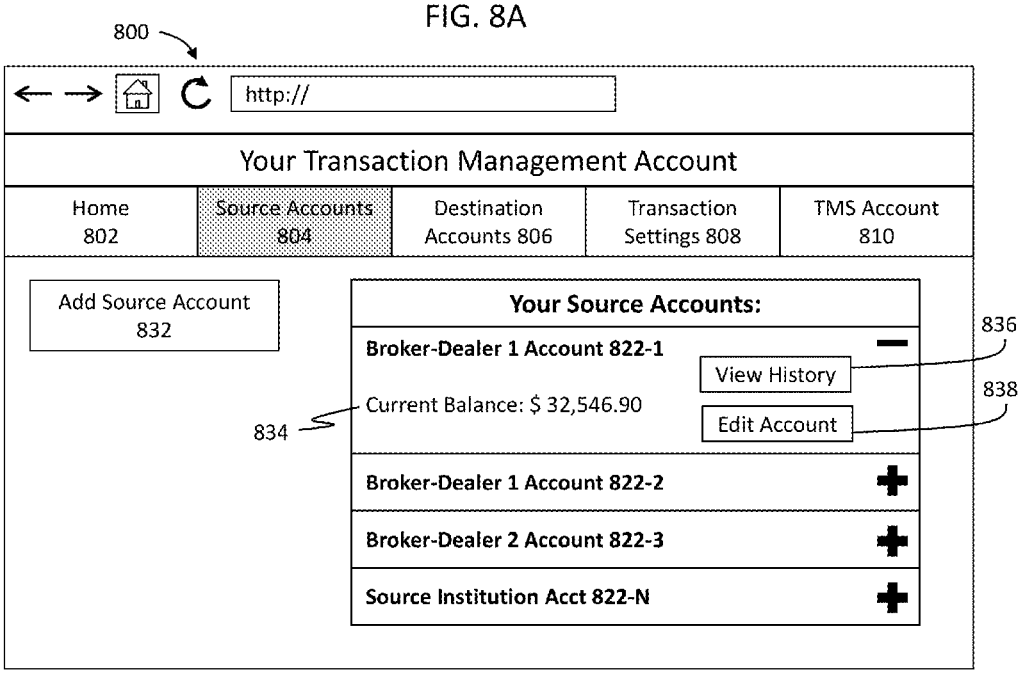
800
http://
Your Transaction Management Account
Home 802
Source Accounts 804
Destination Accounts 806
Transaction Settings 808
TMS Account 810
Add Source Account 832
Your Source Accounts:
Broker-Dealer 1 Account 822-1
View History
Current Balance: $ 32,546.90
Edit Account
Broker-Dealer 1 Account 822-2
Broker-Dealer 2 Account 822-3
Source Institution Acct 822-N
834
836
838

FIG. 8B

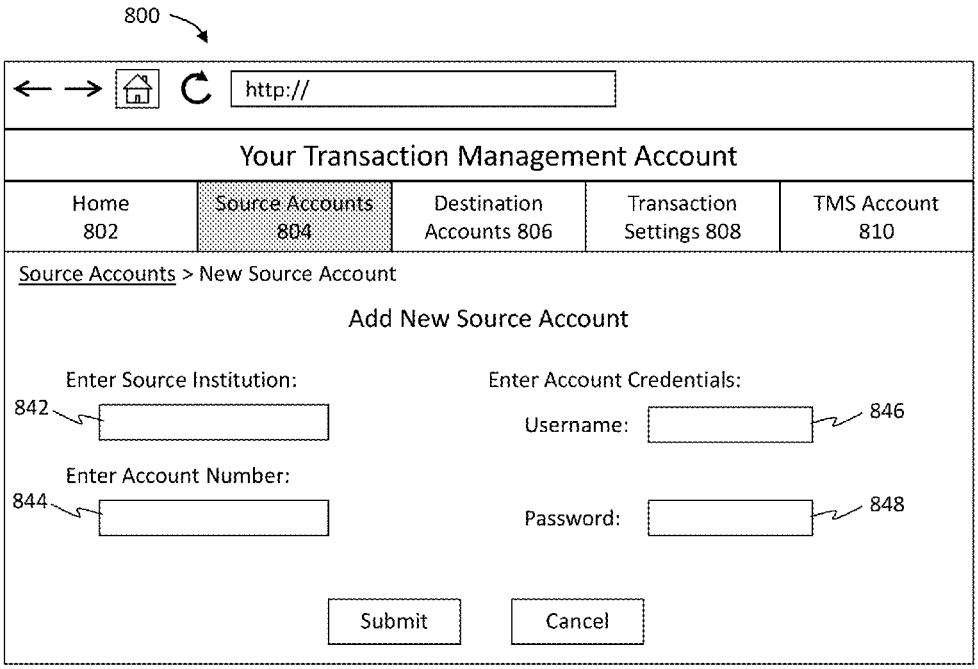
800
http://
Your Transaction Management Account
Home 802
Source Accounts 804
Destination Accounts 806
Transaction Settings 808
TMS Account 810
Source Accounts > New Source Account
Add New Source Account
Enter Source Institution:
842
Enter Account Credentials:
Username:
846
Enter Account Number:
844
Password:
848
Submit
Cancel

FIG. 8C

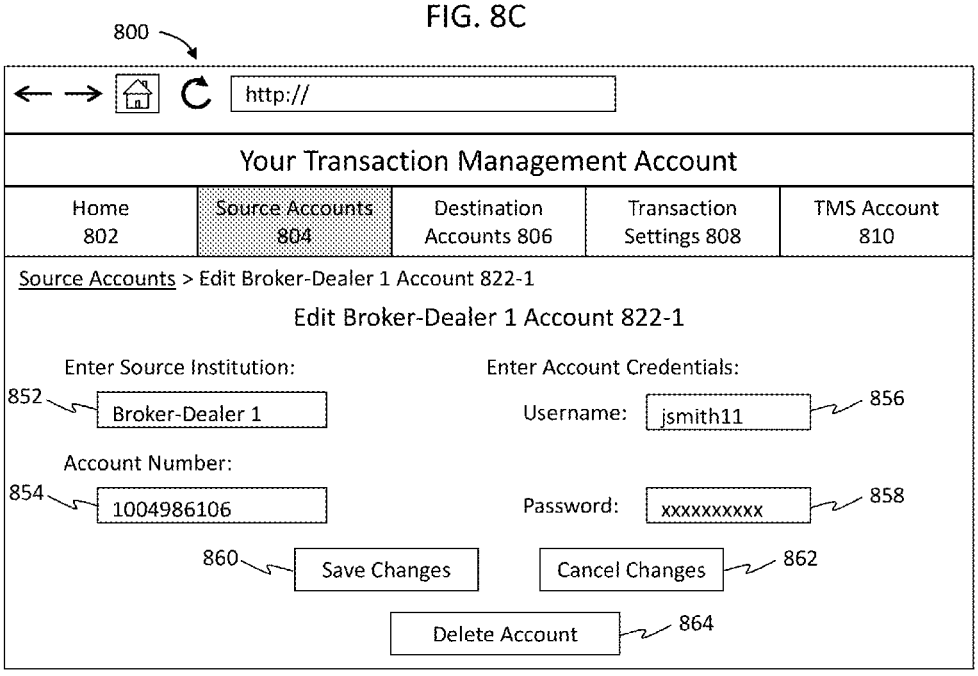
800
http://
Your Transaction Management Account
Home 802
Source Accounts 804
Destination Accounts 806
Transaction Settings 808
TMS Account 810
Source Accounts > Edit Broker-Dealer 1 Account 822-1
Edit Broker-Dealer 1 Account 822-1
Enter Source Institution:
852
Broker-Dealer 1
Enter Account Credentials:
Username:
jsmith11
856
Account Number:
854
1004986106
Password:
xxxxxxxxxx
858
860
Save Changes
Cancel Changes
862
Delete Account
864

FIG. 8D

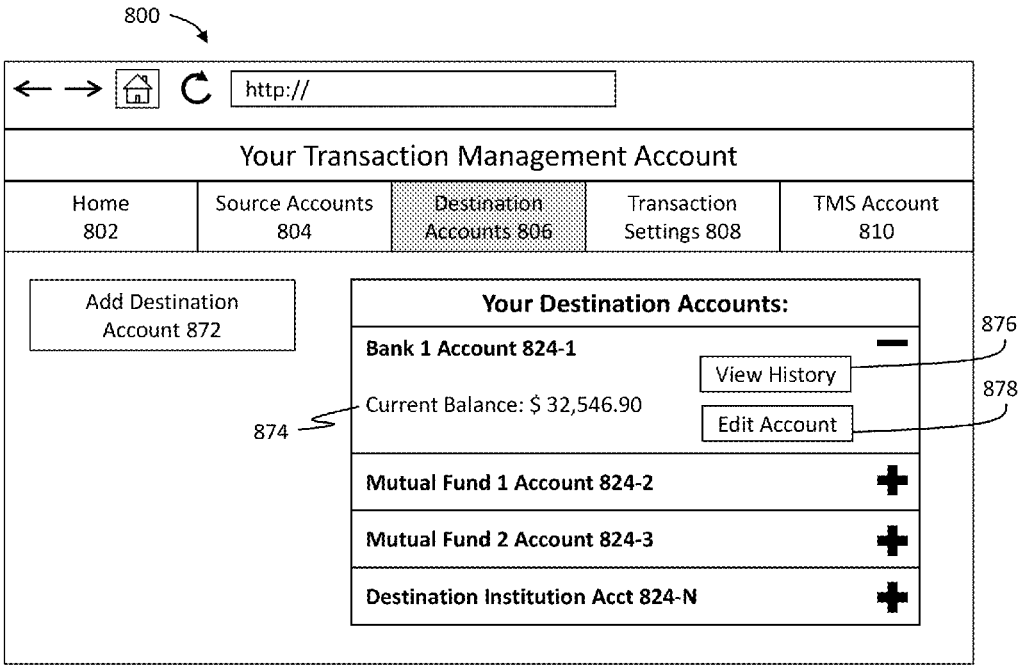
800
http://
Your Transaction Management Account
Home 802
Source Accounts 804
Destination Accounts 806
Transaction Settings 808
TMS Account 810
Add Destination Account 872
Your Destination Accounts:
Bank 1 Account 824-1
View History
Edit Account
Current Balance: $ 32,546.90
874
876
878
Mutual Fund 1 Account 824-2
Mutual Fund 2 Account 824-3
Destination Institution Acct 824-N

FIG. 8E

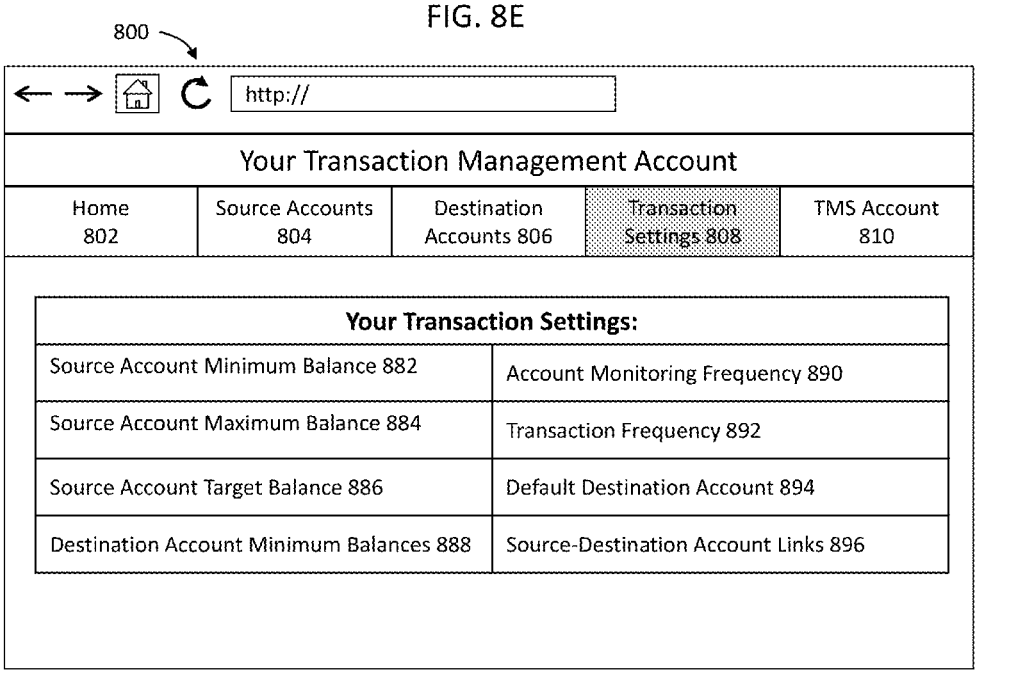
800
http://
Your Transaction Management Account
Home 802
Source Accounts 804
Destination Accounts 806
Transaction Settings 808
TMS Account 810
Your Transaction Settings:
Source Account Minimum Balance 882
Account Monitoring Frequency 890
Source Account Maximum Balance 884
Transaction Frequency 892
Source Account Target Balance 886
Default Destination Account 894
Destination Account Minimum Balances 888
Source-Destination Account Links 896

FIG. 8F

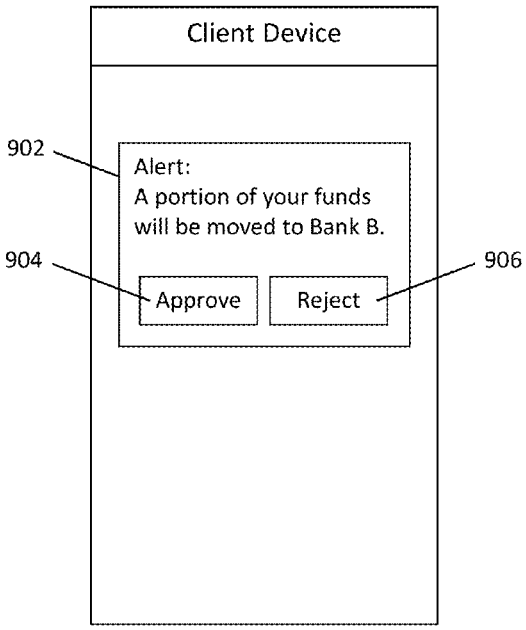

FIG. 9A

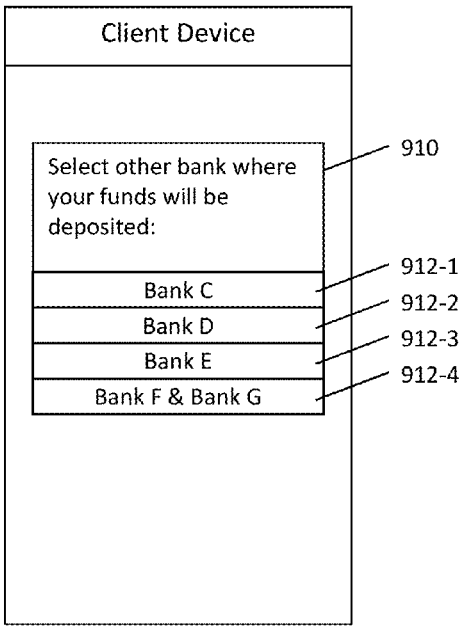

FIG. 9B

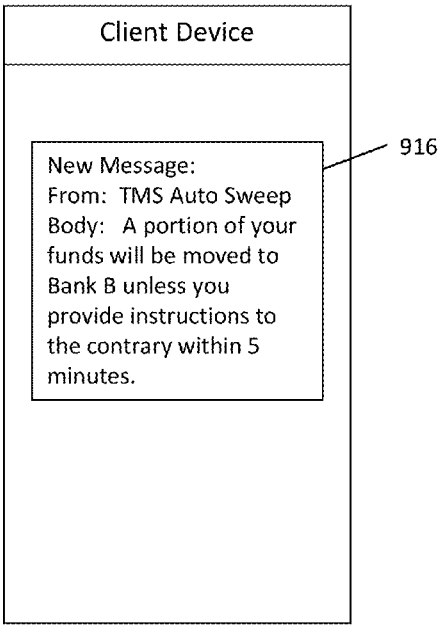

FIG. 9C

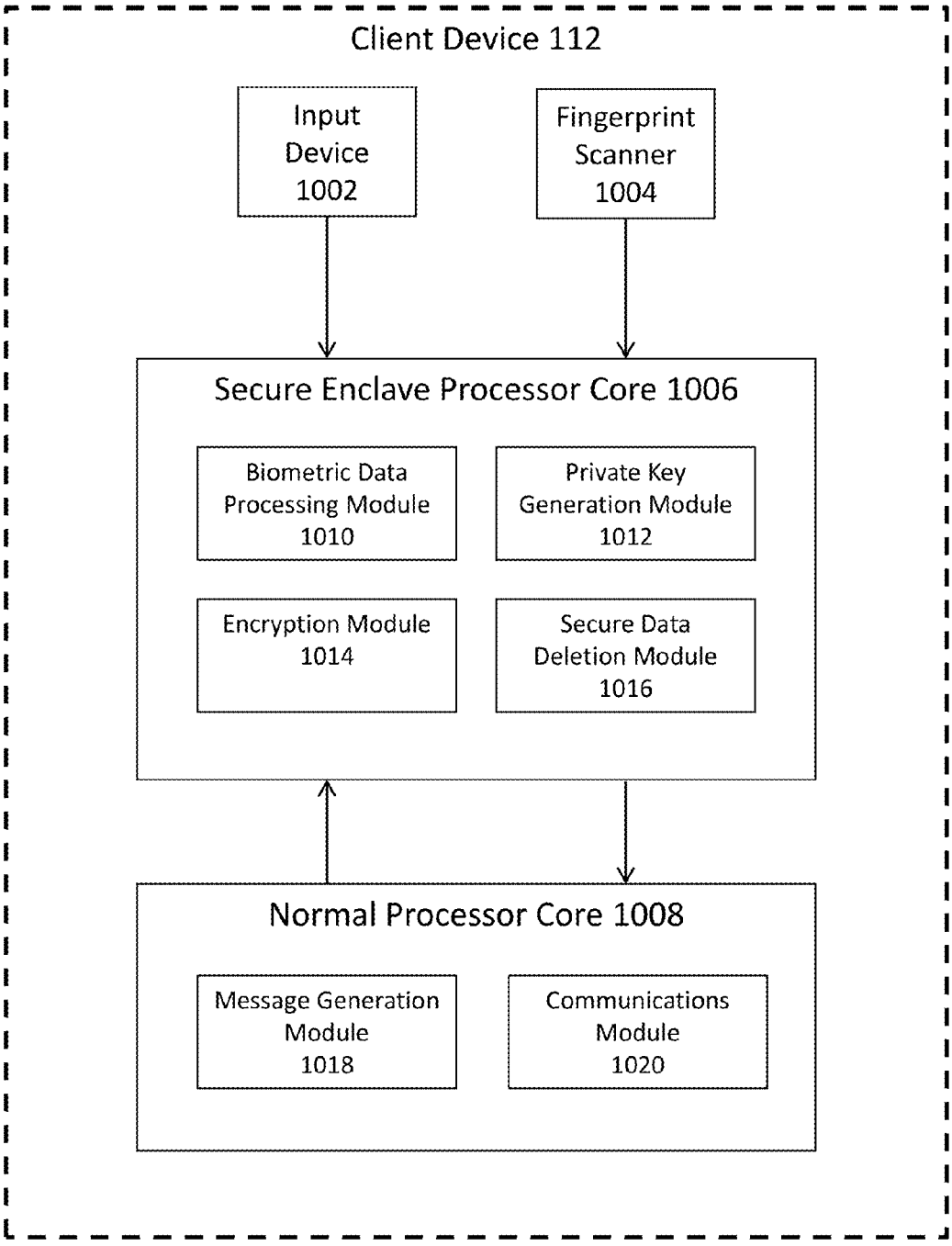
Client Device 112
Input Device 1002
Fingerprint Scanner 1004
Secure Enclave Processor Core 1006
Biometric Data Processing Module 1010
Private Key Generation Module 1012
Encryption Module 1014
Secure Data Deletion Module 1016
Normal Processor Core 1008
Message Generation Module 1018
Communications Module 1020

FIG. 10A

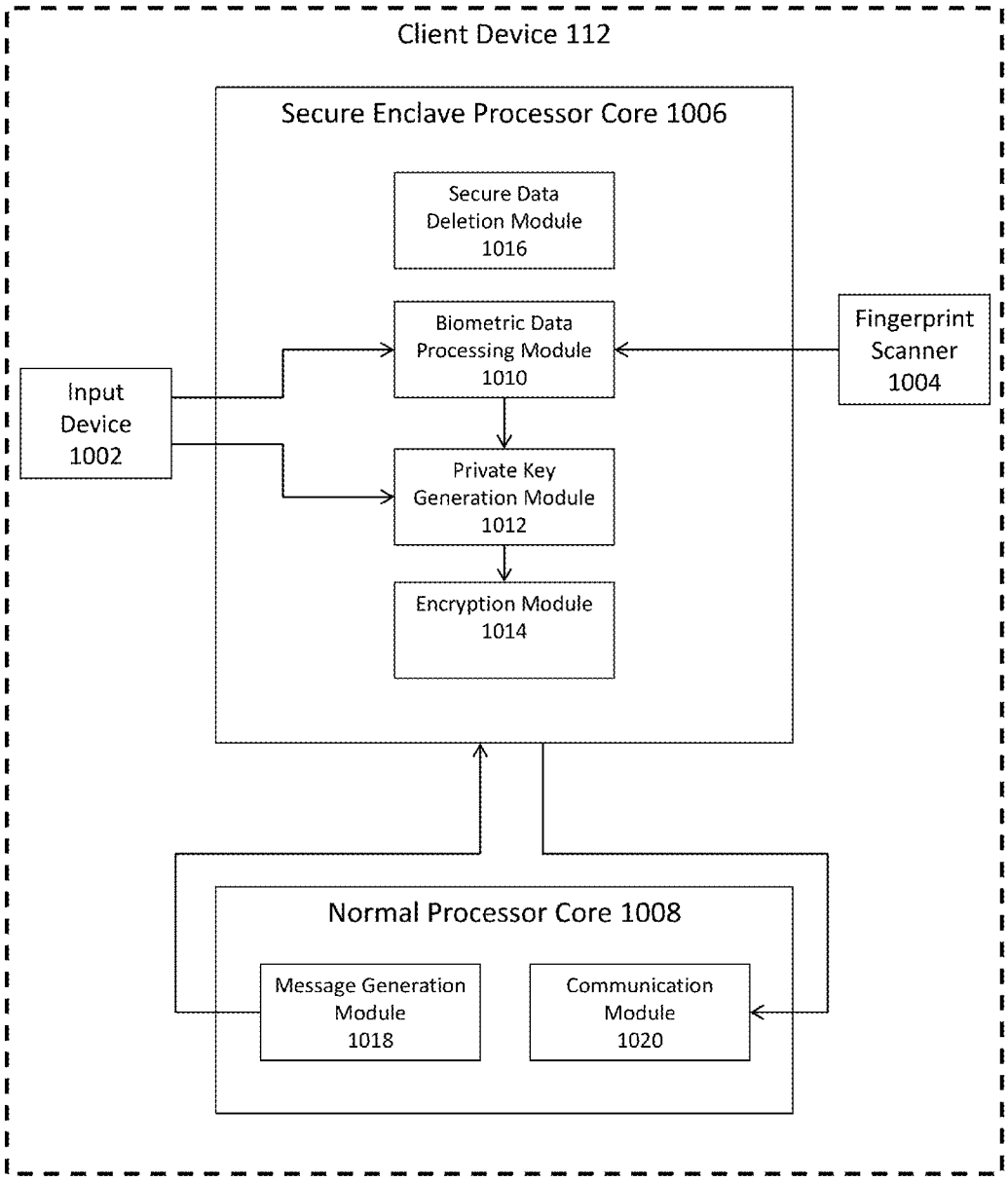
Client Device 112
Secure Enclave Processor Core 1006
Secure Data Deletion Module 1016
Biometric Data Processing Module 1010
Fingerprint Scanner 1004
Input Device 1002
Private Key Generation Module 1012
Encryption Module 1014
Normal Processor Core 1008
Message Generation Module 1018
Communication Module 1020

FIG. 10B

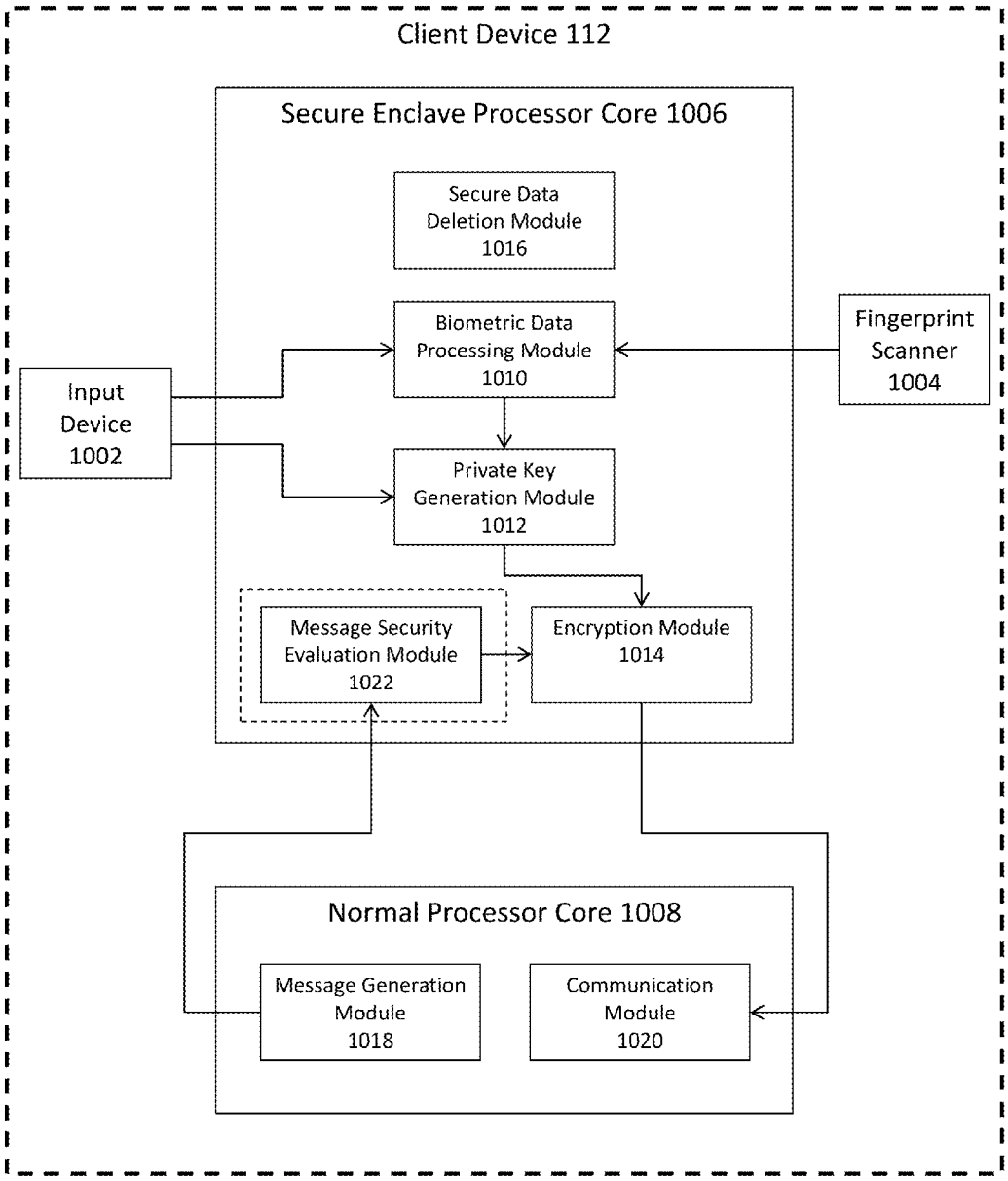
Client Device 112
Secure Enclave Processor Core 1006
Secure Data Deletion Module 1016
Biometric Data Processing Module 1010
Fingerprint Scanner 1004
Input Device 1002
Private Key Generation Module 1012
Message Security Evaluation Module 1022
Encryption Module 1014
Normal Processor Core 1008
Message Generation Module 1018
Communication Module 1020

FIG. 10C

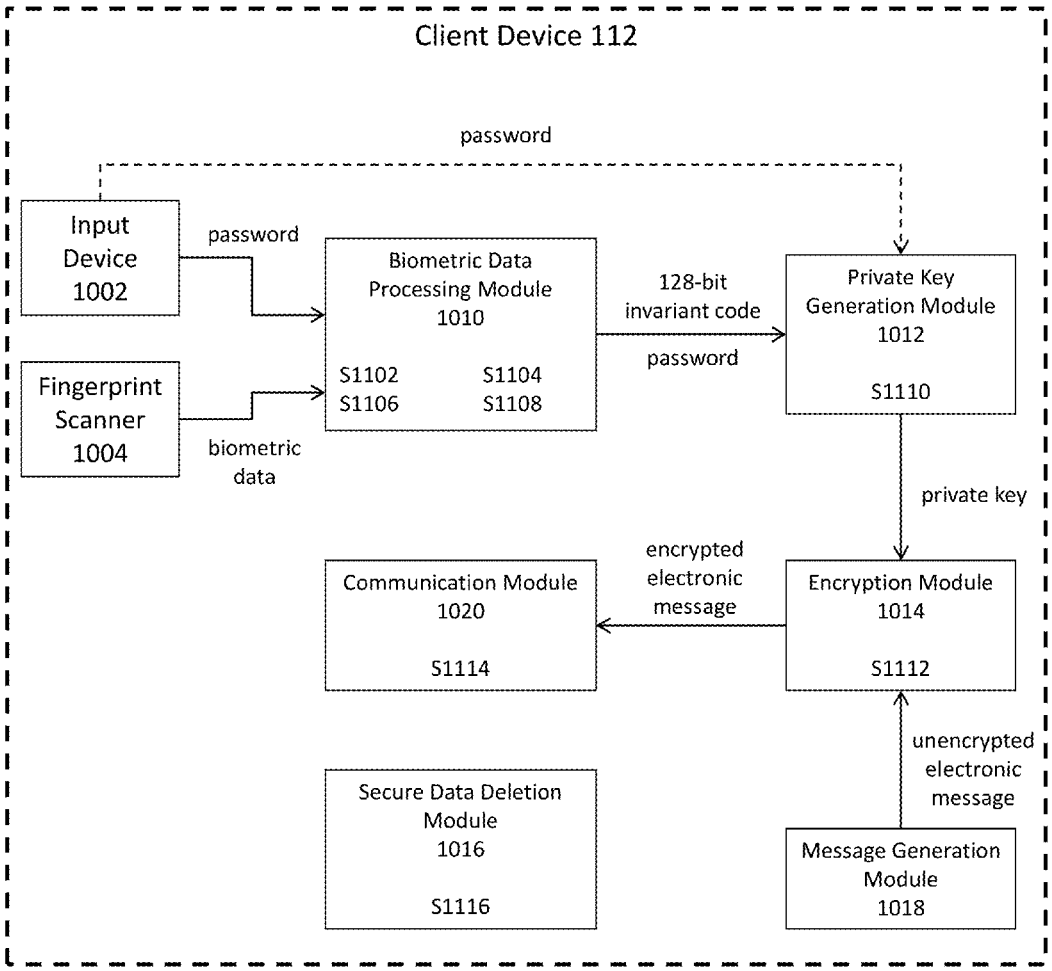
Client Device 112
password
Input Device 1002
password
Biometric Data Processing Module 1010
S1102
S1104
S1106
S1108
128-bit invariant code
password
Private Key Generation Module 1012
S1110
Fingerprint Scanner 1004
biometric data
private key
encrypted electronic message
Communication Module 1020
S1114
Encryption Module 1014
S1112
unencrypted electronic message
Secure Data Deletion Module 1016
S1116
Message Generation Module 1018

FIG. 11A

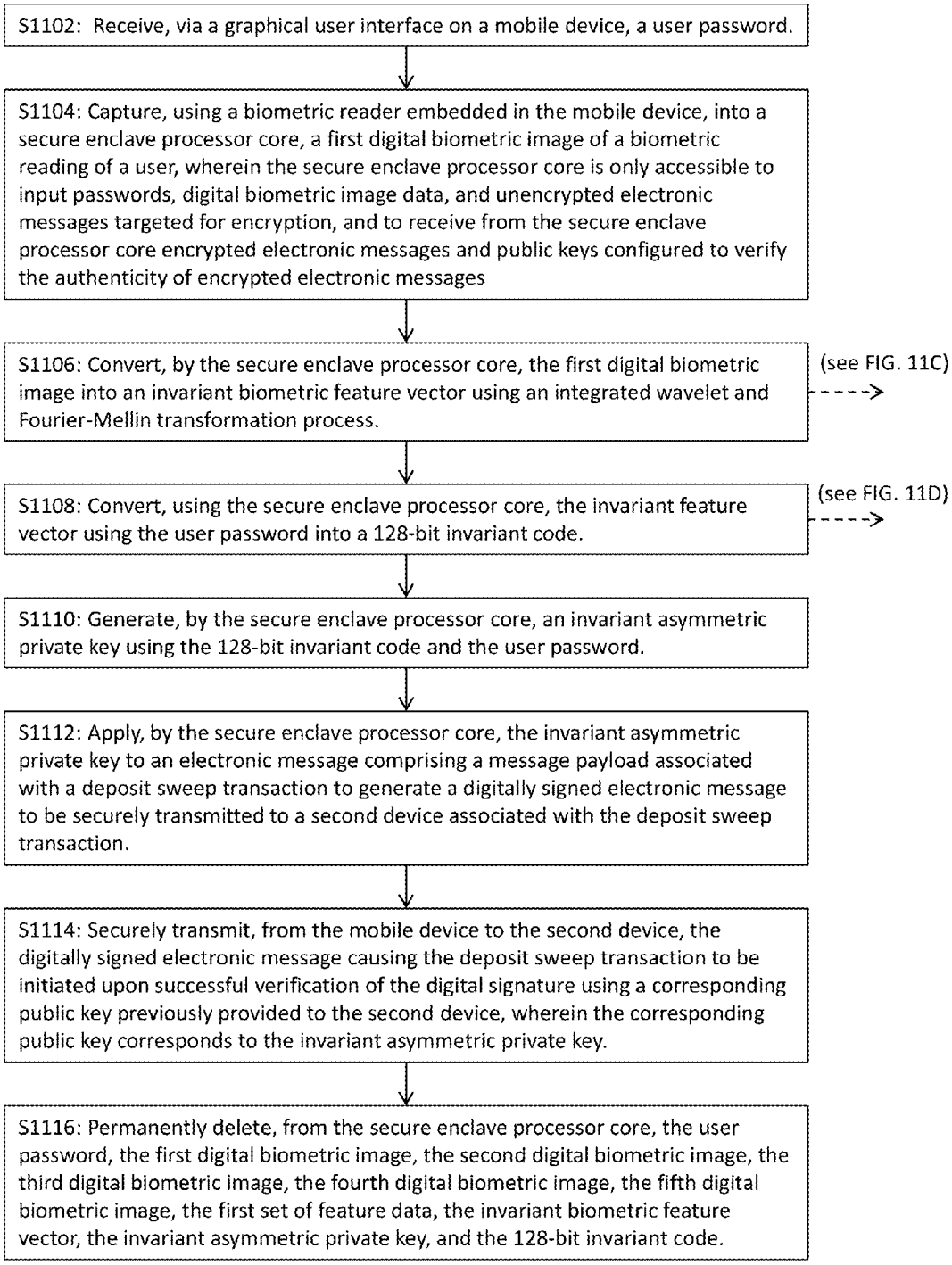
S1102: Receive, via a graphical user interface on a mobile device, a user password.
S1104: Capture, using a biometric reader embedded in the mobile device, into a secure enclave processor core, a first digital biometric image of a biometric reading of a user, wherein the secure enclave processor core is only accessible to input passwords, digital biometric image data, and unencrypted electronic messages targeted for encryption, and to receive from the secure enclave processor core encrypted electronic messages and public keys configured to verify the authenticity of encrypted electronic messages
S1106: Convert, by the secure enclave processor core, the first digital biometric image into an invariant biometric feature vector using an integrated wavelet and Fourier-Mellin transformation process.
(see FIG. 11C)
S1108: Convert, using the secure enclave processor core, the invariant feature vector using the user password into a 128-bit invariant code.
(see FIG. 11D)
S1110: Generate, by the secure enclave processor core, an invariant asymmetric private key using the 128-bit invariant code and the user password.
S1112: Apply, by the secure enclave processor core, the invariant asymmetric private key to an electronic message comprising a message payload associated with a deposit sweep transaction to generate a digitally signed electronic message to be securely transmitted to a second device associated with the deposit sweep transaction.
S1114: Securely transmit, from the mobile device to the second device, the digitally signed electronic message causing the deposit sweep transaction to be initiated upon successful verification of the digital signature using a corresponding public key previously provided to the second device, wherein the corresponding public key corresponds to the invariant asymmetric private key.
S1116: Permanently delete, from the secure enclave processor core, the user password, the first digital biometric image, the second digital biometric image, the third digital biometric image, the fourth digital biometric image, the fifth digital biometric image, the first set of feature data, the invariant biometric feature vector, the invariant asymmetric private key, and the 128-bit invariant code.

FIG. 11B

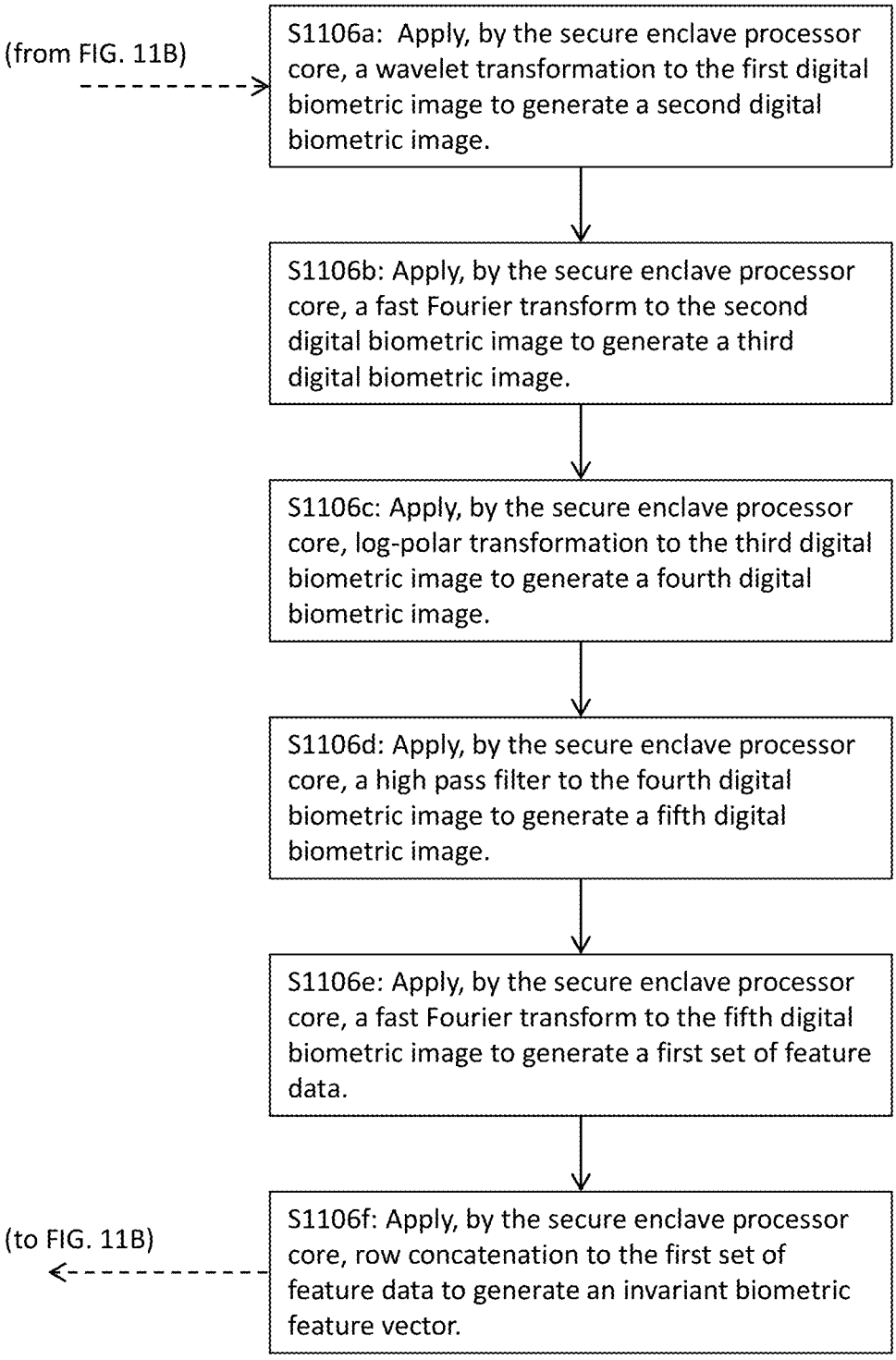
(from FIG. 11B)
S1106a: Apply, by the secure enclave processor core, a wavelet transformation to the first digital biometric image to generate a second digital biometric image.
S1106b: Apply, by the secure enclave processor core, a fast Fourier transform to the second digital biometric image to generate a third digital biometric image.
S1106c: Apply, by the secure enclave processor core, log-polar transformation to the third digital biometric image to generate a fourth digital biometric image.
S1106d: Apply, by the secure enclave processor core, a high pass filter to the fourth digital biometric image to generate a fifth digital biometric image.
S1106e: Apply, by the secure enclave processor core, a fast Fourier transform to the fifth digital biometric image to generate a first set of feature data.
S1106f: Apply, by the secure enclave processor core, row concatenation to the first set of feature data to generate an invariant biometric feature vector.
(to FIG. 11B)

FIG. 11C

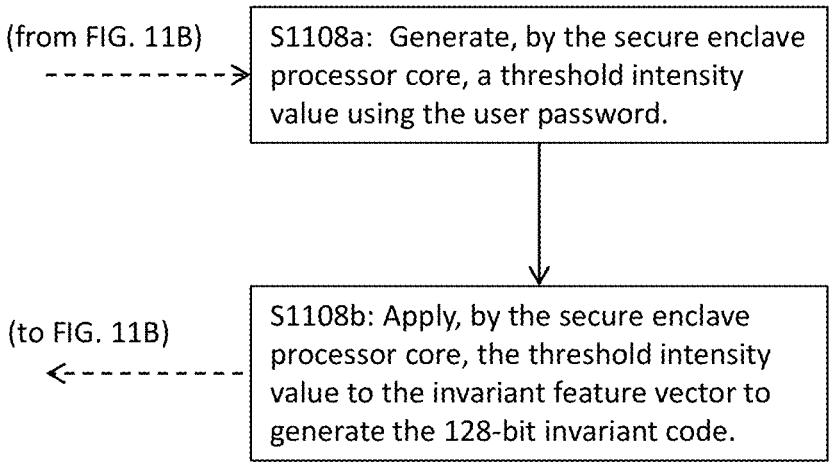
(from FIG. 11B)
S1108a: Generate, by the secure enclave processor core, a threshold intensity value using the user password.
(to FIG. 11B)
S1108b: Apply, by the secure enclave processor core, the threshold intensity value to the invariant feature vector to generate the 128-bit invariant code.

FIG. 11D

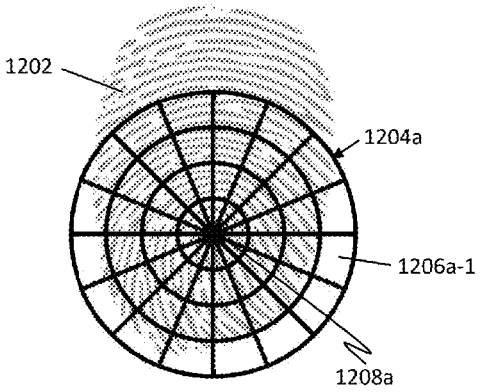

FIG. 12A

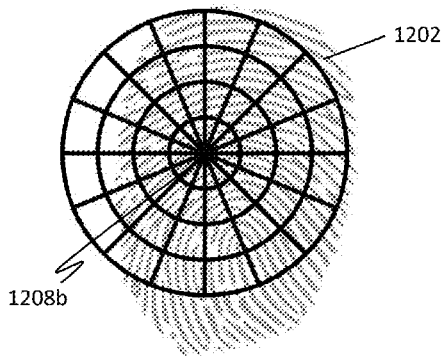

FIG. 12B

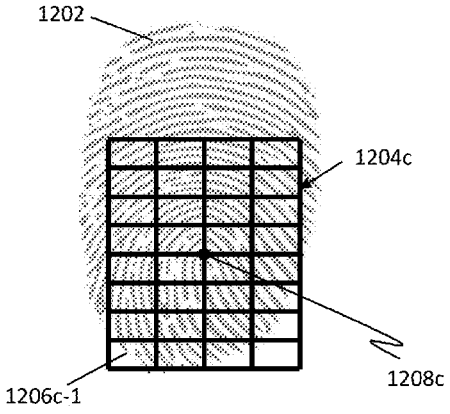

FIG. 12C

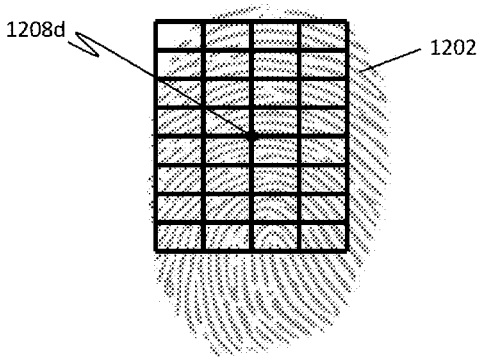

FIG. 12D

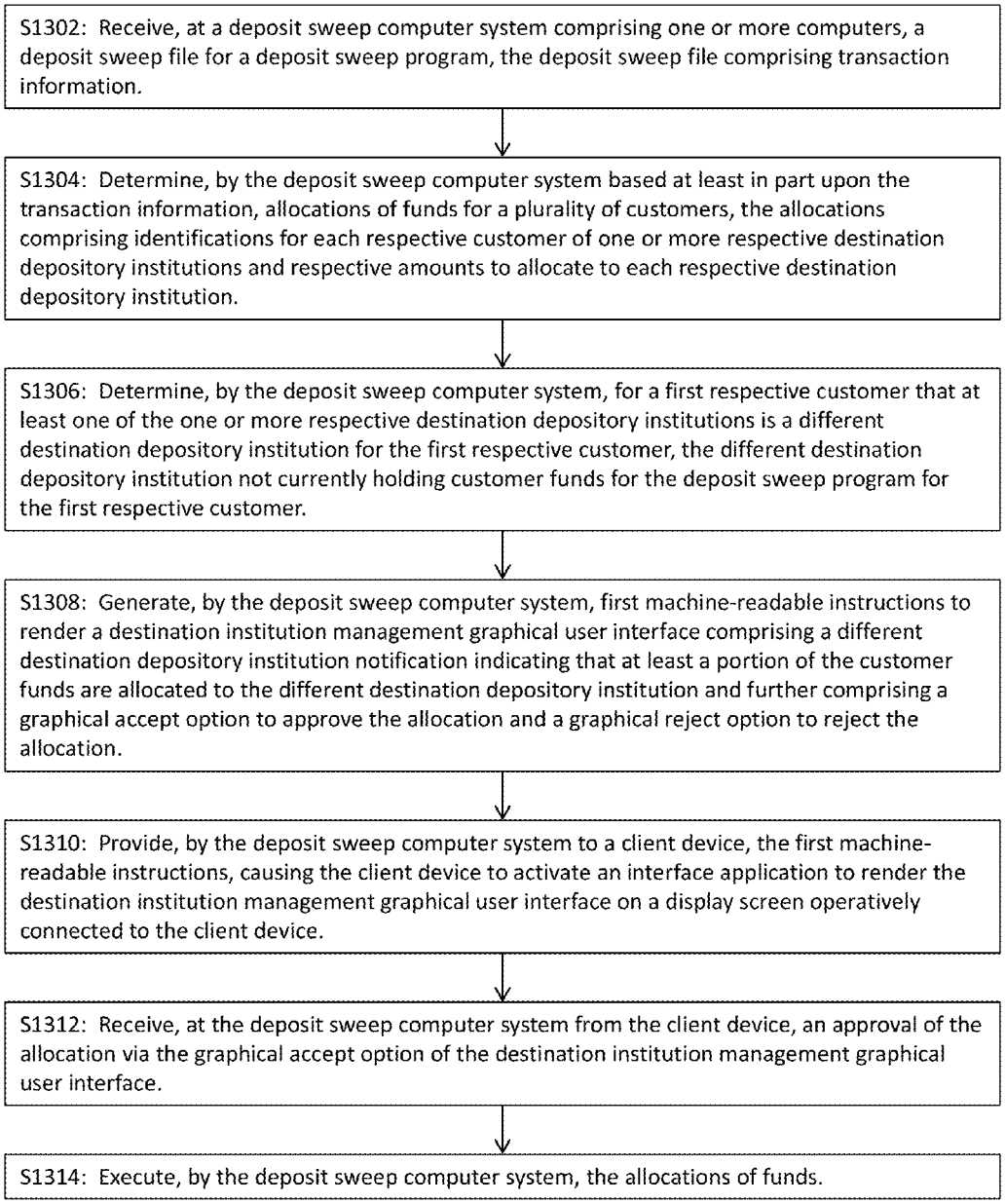
S1302: Receive, at a deposit sweep computer system comprising one or more computers, a deposit sweep file for a deposit sweep program, the deposit sweep file comprising transaction information.
S1304: Determine, by the deposit sweep computer system based at least in part upon the transaction information, allocations of funds for a plurality of customers, the allocations comprising identifications for each respective customer of one or more respective destination depository institutions and respective amounts to allocate to each respective destination depository institution.
S1306: Determine, by the deposit sweep computer system, for a first respective customer that at least one of the one or more respective destination depository institutions is a different destination depository institution for the first respective customer, the different destination depository institution not currently holding customer funds for the deposit sweep program for the first respective customer.
S1308: Generate, by the deposit sweep computer system, first machine-readable instructions to render a destination institution management graphical user interface comprising a different destination depository institution notification indicating that at least a portion of the customer funds are allocated to the different destination depository institution and further comprising a graphical accept option to approve the allocation and a graphical reject option to reject the allocation.
S1310: Provide, by the deposit sweep computer system to a client device, the first machine-readable instructions, causing the client device to activate an interface application to render the destination institution management graphical user interface on a display screen operatively connected to the client device.
S1312: Receive, at the deposit sweep computer system from the client device, an approval of the allocation via the graphical accept option of the destination institution management graphical user interface.
S1314: Execute, by the deposit sweep computer system, the allocations of funds.

FIG. 13A

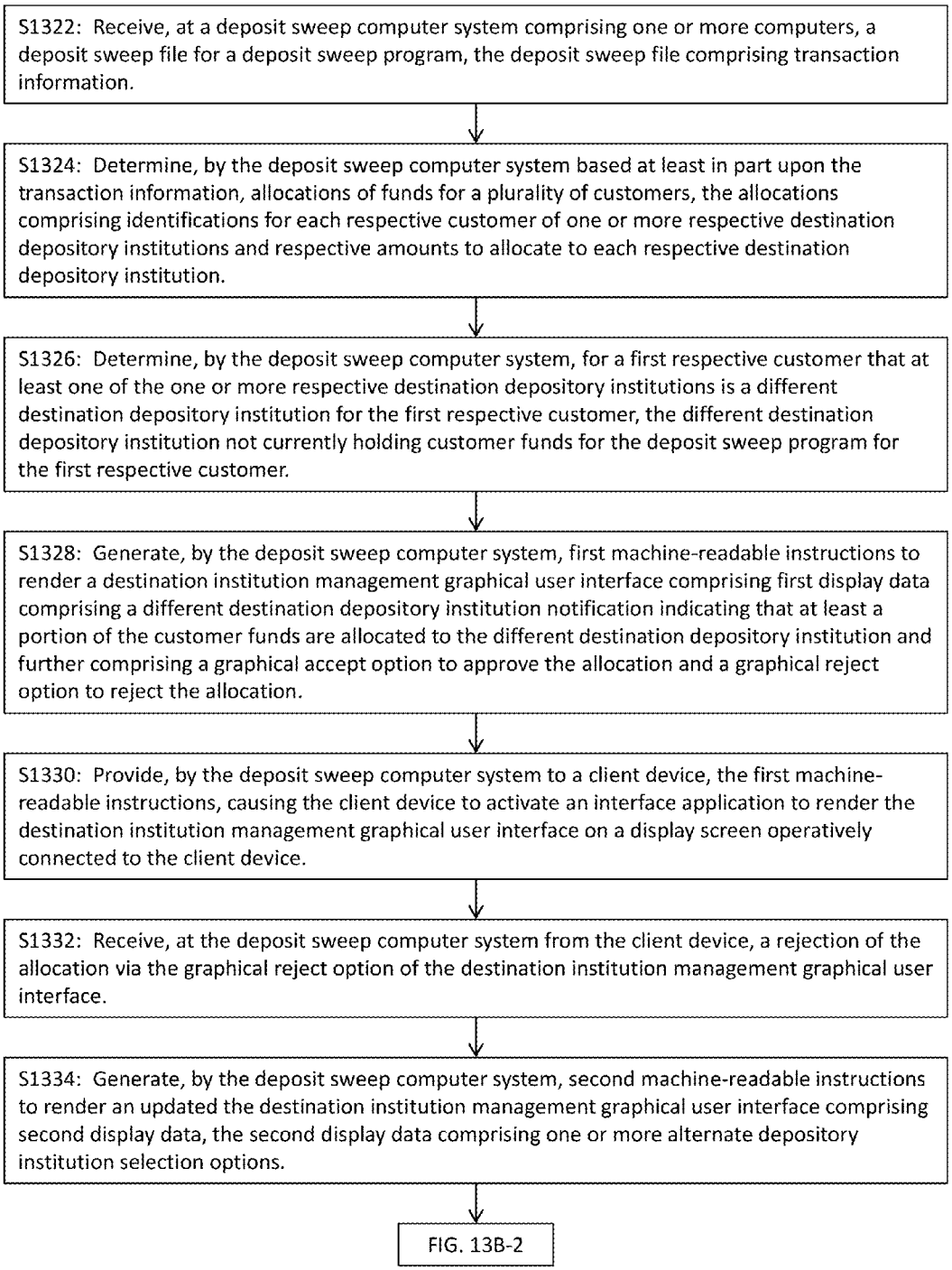
S1322: Receive, at a deposit sweep computer system comprising one or more computers, a deposit sweep file for a deposit sweep program, the deposit sweep file comprising transaction information.
S1324: Determine, by the deposit sweep computer system based at least in part upon the transaction information, allocations of funds for a plurality of customers, the allocations comprising identifications for each respective customer of one or more respective destination depository institutions and respective amounts to allocate to each respective destination depository institution.
S1326: Determine, by the deposit sweep computer system, for a first respective customer that at least one of the one or more respective destination depository institutions is a different destination depository institution for the first respective customer, the different destination depository institution not currently holding customer funds for the deposit sweep program for the first respective customer.
S1328: Generate, by the deposit sweep computer system, first machine-readable instructions to render a destination institution management graphical user interface comprising first display data comprising a different destination depository institution notification indicating that at least a portion of the customer funds are allocated to the different destination depository institution and further comprising a graphical accept option to approve the allocation and a graphical reject option to reject the allocation.
S1330: Provide, by the deposit sweep computer system to a client device, the first machine-readable instructions, causing the client device to activate an interface application to render the destination institution management graphical user interface on a display screen operatively connected to the client device.
S1332: Receive, at the deposit sweep computer system from the client device, a rejection of the allocation via the graphical reject option of the destination institution management graphical user interface.
S1334: Generate, by the deposit sweep computer system, second machine-readable instructions to render an updated the destination institution management graphical user interface comprising second display data, the second display data comprising one or more alternate depository institution selection options.
FIG. 13B-2

FIG. 13B-1

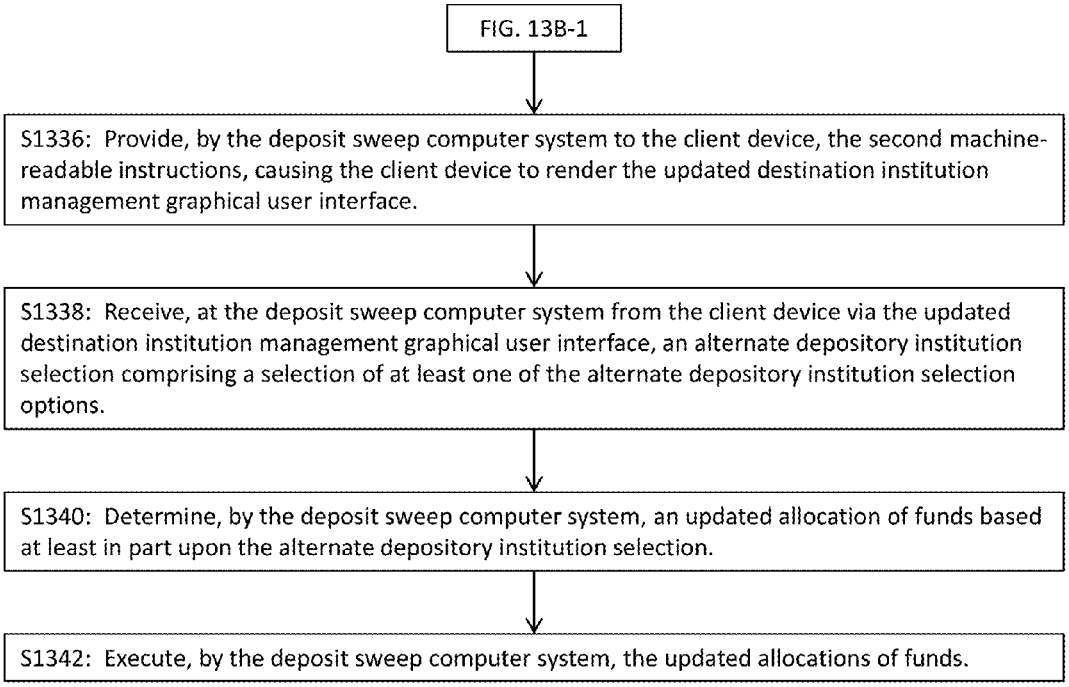
FIG. 13B-1
S1336: Provide, by the deposit sweep computer system to the client device, the second machine-readable instructions, causing the client device to render the updated destination institution management graphical user interface.
S1338: Receive, at the deposit sweep computer system from the client device via the updated destination institution management graphical user interface, an alternate depository institution selection comprising a selection of at least one of the alternate depository institution selection options.
S1340: Determine, by the deposit sweep computer system, an updated allocation of funds based at least in part upon the alternate depository institution selection.
S1342: Execute, by the deposit sweep computer system, the updated allocations of funds.

FIG. 13B-2

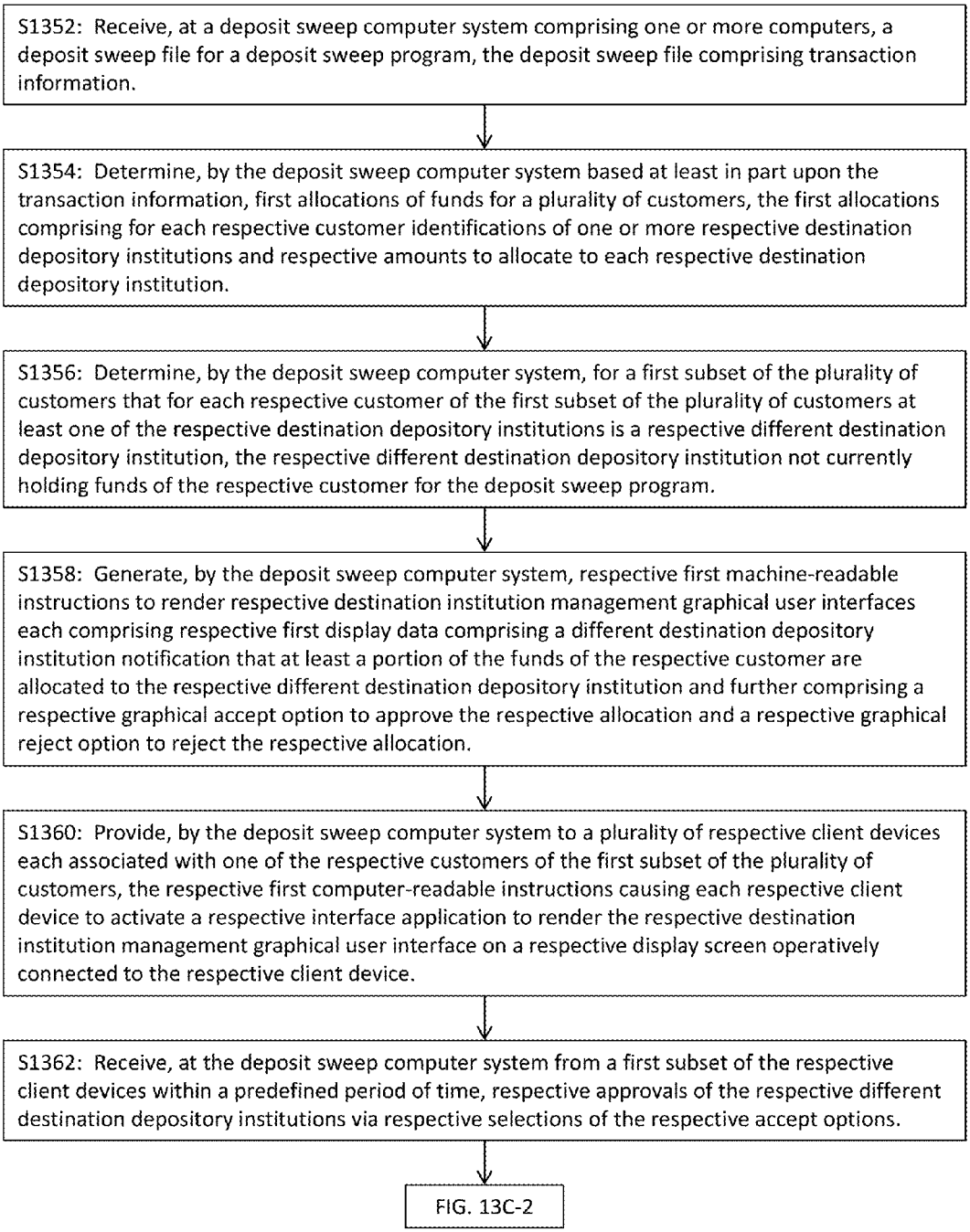
S1352: Receive, at a deposit sweep computer system comprising one or more computers, a deposit sweep file for a deposit sweep program, the deposit sweep file comprising transaction information.
S1354: Determine, by the deposit sweep computer system based at least in part upon the transaction information, first allocations of funds for a plurality of customers, the first allocations comprising for each respective customer identifications of one or more respective destination depository institutions and respective amounts to allocate to each respective destination depository institution.
S1356: Determine, by the deposit sweep computer system, for a first subset of the plurality of customers that for each respective customer of the first subset of the plurality of customers at least one of the respective destination depository institutions is a respective different destination depository institution, the respective different destination depository institution not currently holding funds of the respective customer for the deposit sweep program.
S1358: Generate, by the deposit sweep computer system, respective first machine-readable instructions to render respective destination institution management graphical user interfaces each comprising respective first display data comprising a different destination depository institution notification that at least a portion of the funds of the respective customer are allocated to the respective different destination depository institution and further comprising a respective graphical accept option to approve the respective allocation and a respective graphical reject option to reject the respective allocation.
S1360: Provide, by the deposit sweep computer system to a plurality of respective client devices each associated with one of the respective customers of the first subset of the plurality of customers, the respective first computer-readable instructions causing each respective client device to activate a respective interface application to render the respective destination institution management graphical user interface on a respective display screen operatively connected to the respective client device.
S1362: Receive, at the deposit sweep computer system from a first subset of the respective client devices within a predefined period of time, respective approvals of the respective different destination depository institutions via respective selections of the respective accept options.
FIG. 13C-2

FIG. 13C-1

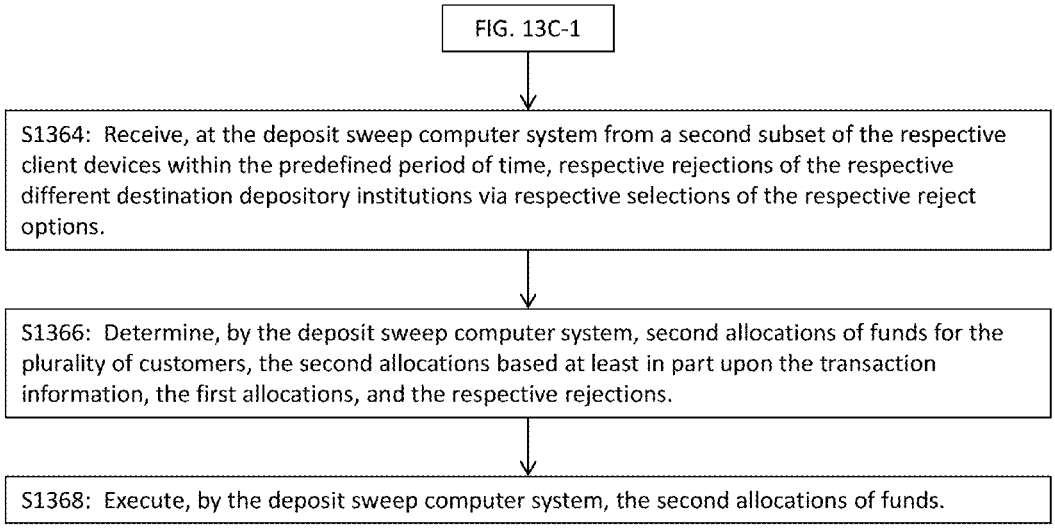
FIG. 13C-1
S1364: Receive, at the deposit sweep computer system from a second subset of the respective client devices within the predefined period of time, respective rejections of the respective different destination depository institutions via respective selections of the respective reject options.
S1366: Determine, by the deposit sweep computer system, second allocations of funds for the plurality of customers, the second allocations based at least in part upon the transaction information, the first allocations, and the respective rejections.
S1368: Execute, by the deposit sweep computer system, the second allocations of funds.

FIG. 13C-2

INVARIANT BIOHASH SECURITY SYSTEM AND METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

This U.S. Patent Application is a continuation application and claims the benefit of co-pending U.S. patent application Ser. No. 14/933,580, filed on Nov. 5, 2015, of the same inventors and entitled "INVARIANT BIOHASH SECURITY SYSTEM AND METHOD", which in turn claims priority from U.S. Provisional Patent Application Ser. No. 62/107,027, filed Jan. 23, 2015, of the same inventors and entitled "COMPUTER OVERRIDE/BYPASS OF ACCOUNT TRANSFER COMPUTER SYSTEMS", the contents of each of which are incorporated by reference as if fully set forth herein.

FIELD OF THE INVENTION

The field of the invention generally relates to various technological improvements in systems, methods, and program products used in cash sweep systems, such as deposit sweep systems. In embodiments, the invention generally relates to biometric-based security systems to ensure authentication of electronic requests associated with cash sweep processes.

BACKGROUND OF THE INVENTION

Deposit sweep systems transfer funds between trading accounts, such as brokerage accounts, and interest bearing deposit accounts, such as bank or other depository accounts and other cash management vehicles. Such systems are implemented using computers specifically programmed to carry out deposit sweep operations, including transfer and allocation operations.

A shortcoming of existing deposit sweep systems is that they require cooperation, on a technological level, from the partner source institutions. Such cooperation can entail ensuring compatibility of the computer systems used to perform deposit sweep transactions, ensuring existence of technological access to source and/or destination computer systems, and ensuring compliance with any restrictions or conditions imposed by the source and destination institutions. Deposit sweep programs thus may require as a preliminary step establishment of technological connections among particular source institutions, destination institutions, and a deposit sweep management computer system. Deposit sweep program offerings may thus be limited to customers of particular partner source and destination institutions, such as brokerage institutions and/or depository institutions, or otherwise may require prospective deposit sweep program customers to establish accounts at such partner institutions. Heretofore, there has been a technological barrier to customers participating in deposit sweep systems without the cooperation and participation of the source institutions from which the funds to be swept are otherwise maintained. Therefore, it is desirable to provide a technical solution that bypasses such need for cooperation and provides greater flexibility to execute deposit sweep transactions with any available source or destination institution.

A second shortcoming of existing deposit sweep systems is the lack of technological mechanisms by which customers can exert control over the computer-implemented deposit sweep transactions to control which banks are used to store the customer's funds. Interaction between a deposit sweep system and an account holder from a separate source institution proves to be difficult among existing deposit sweep systems, and a technological manner in which to obtain such direct interaction, and thus user control, is desirable. Often, if a user knew of which particular depository institution his or her funds are being held at, or are to be held at, at any given moment, a user may object to the use of particular depository institutions for a number of reasons, including lack of insurance, difficulty of access to funds, or personal preference, to name a few reasons. Prior art deposit sweep systems lack technological mechanisms by which users can be informed in real time or even contemporaneously of the institutions at which their funds will be deposited and by which users can exert control over the institutions that are used. Often users must wait for a monthly statement to arrive. Technological improvements over such prior art deposit sweep systems are desired to inject customer control and/or timely notification into automated computer-implemented deposit sweep processes.

A third shortcoming of existing deposit sweep systems is security. Data hacks and phishing scams pose a persistent threat, particularly to data stored on computer systems or verification of user authentication information. Prior art security systems require storage of one or more reference credentials for a user, including biometric information, passwords, pin numbers, and/or fingerprint data, to which user access credentials are compared to authenticate them. The stored reference credentials are subject to data leaks and data breaches. While stored secret information, such as passwords, may be changed if compromised, biometric information cannot be changed as the various biometric signatures of a particular individual are generally unique and non-varying. Moreover, some users are reluctant to store their biometric information either in a device or at a cloud storage system (e.g., at a server), where the user cannot guarantee that others will not be able to access that personal biometric data. In addition to matching with reference credentials, other prior art security systems use public key cryptography that enables a user to provide a digital signature using a private key, which signature is verifiable using a corresponding public key. However, such systems require storage or memorization of the private key, which can be expressed as a large alphanumeric sequence. Memorization can be difficult, and again, stored keys may be leaked or hacked. Therefore it is desirable to provide a security system that does not store secret user credentials but that also does not require a user to input or provide a long private key or store sensitive biometric information which may be subject to a potential data breach.

SUMMARY OF THE INVENTION

An object of the present invention to address one or more the above problems as outlined in the prior art.

The field of the invention generally relates to various technological improvements in systems, methods, and program products used in deposit sweep systems or other cash sweep systems. In embodiments, the invention generally relates to systems, methods, and program products used to bypass technological cooperation from institutions holding trading accounts, depository accounts, and/or other cash management vehicles and/or cash management accounts, such as DDAs, MMDAs, NOW accounts, stable value funds, credit interest programs, to name a few, in order to transfer funds among those accounts freely. In embodiments, the invention further relates generally to biometric-based security systems to ensure authentication of electronic

requests associated with deposit sweep processes. In embodiments, the invention further relates generally to new technological mechanisms to communicate with account holders so that such account holders can control the depository institutions in which funds are being held.

In embodiments, a biometric private key generation system may generate a private key based at least in part upon an input biometric reading and an input password, which may be a personal identification number (PIN). In embodiments, the resulting private key may not be stored but rather may be used to provide a digital signature for an electronic message. The private key may be deleted from the system after it is used to generate the digital signature. The signature may be verified by other entities using a public key corresponding to the private key in accordance with public key cryptography techniques. The private key may be regenerated by inputting both a new instance of the biometric reading as well as a new instance of the password.

In embodiments, a method for generating a secure biometric-based cryptographic key without storing biometric information in order to authenticate data in a deposit sweep transfer system may comprise receiving, via a first graphical user interface on a mobile device, a user password; capturing, using a biometric reader embedded in the mobile device, into a secure enclave processor core, a first digital biometric image of a biometric reading of a user, wherein the secure enclave processor core is only accessible to input passwords, digital biometric image data, and electronic messages targeted for encryption, and to receive from the secure enclave processor core encrypted electronic messages and public keys configured to verify the authenticity of encrypted electronic messages; converting, by the secure enclave processor core, the first digital biometric image into an invariant biometric feature vector using an integrated wavelet and Fourier-Mellin transformation process; converting, by the secure enclave processor core, the invariant feature vector using the user password into a 128-bit invariant code; generating, by the secure enclave processor core, an invariant asymmetric private key using the 128-bit invariant code and the user password; applying, by the secure enclave processor core, the invariant asymmetric private key to an electronic message comprising a message payload associated with a deposit sweep transaction to generate a digitally signed electronic message to be securely transmitted to a second device associated with the deposit sweep transaction; securely transmitting, from the mobile device to the second device, the digitally signed electronic message causing the deposit sweep transaction to be initiated upon successful verification of the digital signature using a corresponding public key previously provided to the second device, wherein the corresponding public key corresponds to the invariant asymmetric private key; and permanently deleting, from the secure enclave processor core, the user password, the first digital biometric image, the second digital biometric image, the third digital biometric image, the fourth digital biometric image, the fifth digital biometric image, the first set of feature data, the invariant biometric feature vector, the invariant asymmetric private key, and the 128-bit invariant code.

In embodiments, converting the first digital biometric image into an invariant biometric feature vector may be performed within the secure enclave processor core by applying, by the secure enclave processor core, a wavelet transformation to the first digital biometric image to generate a second digital biometric image; applying, by the secure enclave processor core, a fast Fourier transform to the second digital biometric image, to generate a third digital biometric image; applying, by the secure enclave processor core, a log-polar transformation to the third digital biometric image to generate a fourth digital biometric image; applying, by the secure enclave processor core, a high pass filter to the fourth digital biometric image to generate a fifth digital biometric image; applying, by the secure enclave processor core, a fast Fourier transform to the fifth digital biometric image to generate a first set of feature data; and applying, by the secure enclave processor core, row concatenation to the first set of feature data to generate the invariant biometric feature vector.

In embodiments, converting, by the secure enclave processor core, the invariant feature vector using the user password into a 128-bit invariant code can comprise generating, by the secure enclave processor core, using the user password a threshold intensity value; and applying, by the secure enclave processor core, the threshold intensity value to the invariant feature vector to generate the 128-bit invariant code.

In embodiments, the user password may be an alphanumeric password that is encoded to convert it to a numeric sequence. In embodiments, the user password may be a personal identification number. The user password may be received via an input device comprising any of a keyboard, keypad, pointer device, touch screen, or microphone.

In embodiments, the biometric reader may be a fingerprint scanner. The fingerprint scanner may be a capacitive fingerprint scanner.

In embodiments, prior to converting the first digital biometric image into an invariant biometric feature vector the secure enclave processor core may convert the first digital biometric image into a sixth digital biometric image by applying a distortion to the first digital biometric image, the distortion based at least in part upon the user password and the sixth digital biometric image to be converted into an invariant biometric feature vector in place of the first digital biometric image.

In embodiments, applying the distortion to the first digital biometric image can comprise selecting from a predefined set of distortion algorithms based at least in part upon a numeric value derived from the user password. In embodiments, applying the distortion to the first digital biometric image can comprise selecting a pixel location associated with a center of distortion based at least in part upon a numeric value derived from the user password.

In embodiments, generating a threshold intensity value using the user password can comprise obtaining, by the secure enclave processor core, a numeric value from the user password; and normalizing, by the secure enclave processor core, the numeric value within a predefined intensity range of possible intensity values by scaling the numeric value based at least in part upon a relation between a range of possible numeric values and the predefined intensity range.

In embodiments, applying the threshold intensity value to the invariant feature vector to generate the 128-bit invariant code can comprise generating, using the threshold intensity value, a sequence of real numbers comprising a set of pseudo-random vectors; applying a Gram-Schmidt orthonormalization to the set of pseudo-random vectors to transform them into an orthonormal set of vectors; computing an inner product between the invariant biometric feature vector and the orthonormal set of vectors; assigning a value of zero to each inner product value less than the threshold intensity value and assigning a value of one to each inner product value greater than the threshold intensity value; mapping each value to a bit location based at least in part upon the location within the biometric feature vector; and aggregating

the values in their respective locations to produce a bit string. In embodiments, applying the threshold intensity value to the invariant feature vector to generate the 128-bit invariant code can further comprise, prior to computing the inner product, normalizing the invariant biometric feature vector between the values negative one and positive one.

In embodiments, applying, by the secure enclave processor core, the invariant asymmetric private key to an electronic message can comprise receiving, at the secure enclave processor core from a normal processor core, the electronic message; evaluating, by the secure enclave processor core, the electronic message to verify the message data format; generating, by the secure enclave processor core, a message digest by computing a hash of the message payload; and encrypting, by the secure enclave processor core, the message digest using the private key.

In embodiments, a system for generating a secure biometric-based cryptographic key without storing biometric information in order to authenticate data in a deposit sweep transfer system can comprise one or more processors (e.g., of a mobile device) and non-transitory computer-readable memory having stored thereon instructions to perform the steps of receiving, via a first graphical user interface on a mobile device, a user password; capturing, using a biometric reader embedded in the mobile device, into a secure enclave processor core, a first digital biometric image of a biometric reading of a user, wherein the secure enclave processor core is only accessible to input passwords, digital biometric image data, and electronic messages targeted for encryption, and to receive from the secure enclave processor core encrypted electronic messages and public keys configured to verify the authenticity of encrypted electronic messages; converting, by the secure enclave processor core, the first digital biometric image into an invariant biometric feature vector using an integrated wavelet and Fourier-Mellin transformation process; converting, by the secure enclave processor core, the invariant feature vector using the user password into a 128-bit invariant code; generating, by the secure enclave processor core, an invariant asymmetric private key using the 128-bit invariant code and the user password; applying, by the secure enclave processor core, the invariant asymmetric private key to an electronic message comprising a message payload associated with a deposit sweep transaction to generate a digitally signed electronic message to be securely transmitted to a second device associated with the deposit sweep transaction; securely transmitting, from the mobile device to the second device, the digitally signed electronic message causing the deposit sweep transaction to be initiated upon successful verification of the digital signature using a corresponding public key previously provided to the second device, wherein the corresponding public key corresponds to the invariant asymmetric private key; and permanently deleting, from the secure enclave processor core, the user password, the first digital biometric image, the second digital biometric image, the third digital biometric image, the fourth digital biometric image, the fifth digital biometric image, the first set of feature data, the invariant biometric feature vector, the invariant asymmetric private key, and the 128-bit invariant code.

In embodiments, a method for performing deposit sweep transactions that bypass source and/or destination institution technological cooperation can comprise obtaining, by one or more transaction management computers from one or more databases comprising non-transitory computer-readable memory, source account access information for a source account of a client, the source account held at a source institution and the source account access information comprising source account identifying information and source account authentication information; obtaining, by the one or more transaction management computers, one or more transaction rules; obtaining, by the one or more transaction management computers according to the one or more transaction rules, source account transaction data comprising one or more buy orders and/or sell orders for the source account by accessing, by the one or more transaction management computers using the source account access information, a source account information portal of a source institution computer system associated with the source institution, wherein access to the source account information portal does not require specialized technological access to the source institution computer system or authorization from the source institution beyond the technological access and authorization provided to the client, and by obtaining, via the source account information portal, the source account transaction data; determining, by the one or more transaction management computers, that the source transaction data represents a net buy order having a net buy amount based at least in part on information in the transaction data; obtaining, by the one or more transaction management computers via the source account information portal, source account balance information for the source account comprising a source account balance; determining, by the one or more transaction management computers, that the source account balance does not equal or exceed the net buy amount for the net buy order; determining, by the one or more transaction management computers, a deficiency amount based at least in part on the source account balance information and the net buy amount; accessing, by the one or more transaction management computers, the one or more databases to obtain depository account access information for a depository account held at a depository institution, the depository account access information comprising at least depository account identifying information and depository account authentication information; obtaining, by the one or more transaction management computers, depository account balance information for the depository account comprising a depository account balance by accessing, by the one or more transaction management computers using the depository account access information, a depository account information portal of a depository institution computer system associated with the depository institution, wherein access to the depository account information portal does not require specialized technological access to the depository institution computer system or authorization from the depository institution beyond the technological access and authorization provided to the client, and by obtaining, via the depository account information portal, the depository account balance information; determining, by the one or more transaction management computers, that the depository account balance equals the deficiency amount or exceeds the deficiency amount by at least a depository account balance threshold amount; generating, by the one or more transaction management computers, electronic transaction instructions for a transfer of at least the deficiency amount from the depository account to the source account; providing, by the one or more transaction management computers to the depository institution computer system via a depository account transaction portal of the depository institution computer system, the electronic transaction instructions causing the depository institution computer system to execute the transfer; generating, by the one or more transaction management computers, an electronic notification of the transfer; and transmitting, by the

one or more transaction management computers to a client device associated with the client, the electronic notification of the transfer.

In embodiments, the method for performing deposit sweep transactions can further comprise determining, by the one or more transaction management computers, that the deficiency amount exceeds the depository account balance; generating, by the one or more transaction management computers, a second electronic notification comprising an indication of the deficiency amount; and transmitting, by the one or more transaction management computers to the client device, the second electronic notification.

In embodiments, the method for performing deposit sweep transactions can further comprise generating, by one or more transaction management computers, first machine-readable instructions to render an account access information graphical user interface comprising account credential input fields; transmitting, from the one or more transaction management computers to a client device, the first machine-readable instructions, causing an interface application at the client device to be activated to render the account access information graphical user interface on a display screen operatively connected to the client device; receiving, at the one or more transaction management computers from the client device via the account access information graphical user interface, source account access information for a source account of a client associated with the client device, the source account held at a source institution and the source account access information comprising source account identifying information and source account authentication information; and storing, by the one or more transaction management computers, the source account access information in one or more databases comprising non-transitory computer-readable memory.

In embodiments, the one or more transaction rules may comprise an account monitoring frequency for obtaining source account transaction data. In embodiments, the one or more transaction rules comprise a source account minimum balance amount. In embodiments, determining, by the one or more transaction management computers, that the source account balance does not equal or exceed the net buy amount for the net buy order may comprise determining that the source account balance does not exceed the net buy amount by at least the source account minimum balance amount.

In embodiments, the one or more transaction management computers may obtain depository account balance information for a plurality of depository accounts. The method may further comprise generating, by the one or more transaction management computers, electronic transaction instructions for transfers of a portion of at least the deficiency amount from each of a plurality of the depository accounts to the source account; and providing, by the one or more transaction management computers to respective depository institution computer systems via respective depository account transaction portals, the electronic transaction instructions causing the depository institution computer systems to execute the transfers. The one or more transaction management computers may determine the depository accounts from which to transfer funds based at least in part upon the transaction rules. In embodiments, the transaction rules may comprise any of minimizing a number of transfers necessary to cover the deficiency amount, preferencing depository accounts that have no FDIC coverage, or using depository accounts according to a preference order specified by the client.

In embodiments, the depository account balance threshold amount may be a depository account minimum balance.

In embodiments, the method may further comprise, prior to the step of generating, by the one or more transaction management computers, electronic transaction instructions, the steps of generating, a second electronic notification comprising an indication of a proposed sweep transfer of at least the deficiency amount from the depository account to the source account and a request for authorization to proceed with the proposed sweep transfer; and transmitting, from the one or more transaction management computers to the client device, the second electronic notification. In embodiments, the one or more transaction management computers may receive an electronic authorization to proceed with the proposed sweep transfer. The electronic authorization may be encrypted using an asymmetric private key generated based at least in part upon an invariant biometric feature vector associated with the client.

In embodiments, the source account information portal may comprise an application programming interface. In embodiments, the source account information portal may comprise a website accessible at a URL via the Internet. Obtaining, via the source account information portal, the source account transaction data may comprise screen scraping.

In embodiments, the electronic notification may comprise an updated source account balance after the transfer is executed or an updated depository account balance after the transfer is executed.

In embodiments, the electronic transaction instructions may comprise ACH instructions.

In embodiments, a system for performing deposit sweep transactions that bypass source and/or destination institution technological cooperation can comprise one or more processors and non-transitory computer-readable memory having stored thereon instructions to perform the steps of obtaining, by one or more transaction management computers from one or more databases comprising non-transitory computer-readable memory, source account access information for a source account of a client, the source account held at a source institution and the source account access information comprising source account identifying information and source account authentication information; obtaining, by the one or more transaction management computers, one or more transaction rules; obtaining, by the one or more transaction management computers according to the one or more transaction rules, source account transaction data comprising one or more buy orders and/or sell orders for the source account by accessing, by the one or more transaction management computers using the source account access information, a source account information portal of a source institution computer system associated with the source institution, wherein access to the source account information portal does not require specialized technological access to the source institution computer system or authorization from the source institution beyond the technological access and authorization provided to the client, and by obtaining, via the source account information portal, the source account transaction data; determining, by the one or more transaction management computers, that the source transaction data represents a net buy order having a net buy amount based at least in part on information in the transaction data; obtaining, by the one or more transaction management computers via the source account information portal, source account balance information for the source account comprising a source account balance; determining, by the one or more transaction management computers, that the source account balance does not equal or exceed the net buy amount for the net buy order; determining, by the one or more transaction

management computers, a deficiency amount based at least in part on the source account balance information and the net buy amount; accessing, by the one or more transaction management computers, the one or more databases to obtain depository account access information for a depository account held at a depository institution, the depository account access information comprising at least depository account identifying information and depository account authentication information; obtaining, by the one or more transaction management computers, depository account balance information for the depository account comprising a depository account balance by accessing, by the one or more transaction management computers using the depository account access information, a depository account information portal of a depository institution computer system associated with the depository institution, wherein access to the depository account information portal does not require specialized technological access to the depository institution computer system or authorization from the depository institution beyond the technological access and authorization provided to the client, and by obtaining, via the depository account information portal, the depository account balance information; determining, by the one or more transaction management computers, that the depository account balance equals the deficiency amount or exceeds the deficiency amount by at least a depository account balance threshold amount; generating, by the one or more transaction management computers, electronic transaction instructions for a transfer of at least the deficiency amount from the depository account to the source account; providing, by the one or more transaction management computers to the depository institution computer system via a depository account transaction portal of the depository institution computer system, the electronic transaction instructions causing the depository institution computer system to execute the transfer; generating, by the one or more transaction management computers, an electronic notification of the transfer; and transmitting, by the one or more transaction management computers to a client device associated with the client, the electronic notification of the transfer.

In embodiments, a method for performing deposit sweep transactions that bypass source and/or destination institution technological cooperation can comprise obtaining, by one or more transaction management computers from one or more databases comprising non-transitory computer-readable memory, source account access information for a source account of a client, the source account held at a source institution and the source account access information comprising source account identifying information and source account authentication information; obtaining, by the one or more transaction management computers, one or more transaction rules comprising at least a source account maximum balance; obtaining, by the one or more transaction management computers, source account balance information for the source account comprising a source account balance by accessing, by the one or more transaction management computers using the source account access information, a source account information portal of a source institution computer system associated with the source institution, wherein access to the source account information portal does not require specialized technological access to the source institution computer system or authorization from the source institution beyond the technological access and authorization provided to the client, and by obtaining, via the source account information portal, the source account balance information; determining, by the one or more transaction management computers, that the source account balance exceeds the source account maximum balance; determining, by the one or more transaction management computers, an excess amount based at least in part upon the source account balance and the source account maximum balance; accessing, by the one or more transaction management computers, the one or more databases to obtain depository account information for a depository account held at a depository institution, the depository account information comprising at least a depository account address; generating, by the one or more transaction management computers, electronic transaction instructions for a transfer of at least the excess amount from the source account to the depository account; providing, by the one or more transaction management computers to the source institution computer system via a source account transaction portal of the source institution computer system, the electronic transaction instructions causing the source institution computer system to execute the transfer; generating, by the one or more transaction management computers, an electronic notification of the transfer; and transmitting, by the one or more transaction management computers to the client device, the electronic notification of the transfer.

In embodiments, the method may further comprise generating, by one or more transaction management computers, first machine-readable instructions to render an account access information graphical user interface comprising account credential input fields; transmitting, from the one or more transaction management computers to a client device, the first machine-readable instructions, causing an interface application at the client device to be activated to render the account access information graphical user interface on a display screen operatively connected to the client device; receiving, at the one or more transaction management computers from the client device via the account access information graphical user interface, source account access information for a source account of a client associated with the client device, the source account held at a source institution and the source account access information comprising source account identifying information and source account authentication information; and storing, by the one or more transaction management computers, the source account access information in one or more databases comprising non-transitory computer-readable memory.

In embodiments, the method may further comprise obtaining, by the one or more transaction management computers, depository account access information comprising at least depository account authentication information; obtaining, by the one or more transaction management computers, depository account balance information for the depository account comprising a depository account balance by accessing, by the one or more transaction management computers using the depository account access information, a depository account information portal of a depository institution computer system associated with the depository institution, wherein access to the depository account information portal does not require specialized technological access to the depository institution computer system or authorization from the depository institution beyond the technological access and authorization provided to the client, and by obtaining, via the depository account information portal, the depository account balance information; obtaining, by the one or more transaction management computers, depository account maximum balance information comprising a depository account maximum balance; and determining, by the one or more transaction manage-

ment computers, that a post-transfer depository account balance will not exceed the depository account maximum balance.

In embodiments, the depository account maximum balance may be based at least in part upon a maximum insurable amount for FDIC insurance.

In embodiments, the transaction rules may further comprise an account monitoring frequency for obtaining source account balance data.

In embodiments, the source account information portal may comprise an application programming interface. In embodiments, the source account information portal may comprise a website accessible at a URL via the Internet. Obtaining, via the source account information portal, the source account balance information may comprise screen scraping.

In embodiments, the electronic transaction instructions may comprise ACH instructions.

In embodiments, a system for performing deposit sweep transactions that bypass source and/or destination institution technological cooperation can comprise one or more processors and non-transitory computer-readable memory having stored thereon instructions to perform the steps of obtaining, by one or more transaction management computers from one or more databases comprising non-transitory computer-readable memory, source account access information for a source account of a client, the source account held at a source institution and the source account access information comprising source account identifying information and source account authentication information; obtaining, by the one or more transaction management computers, one or more transaction rules comprising at least a source account maximum balance; obtaining, by the one or more transaction management computers, source account balance information for the source account comprising a source account balance by accessing, by the one or more transaction management computers using the source account access information, a source account information portal of a source institution computer system associated with the source institution, wherein access to the source account information portal does not require specialized technological access to the source institution computer system or authorization from the source institution beyond the technological access and authorization provided to the client, and by obtaining, via the source account information portal, the source account balance information; determining, by the one or more transaction management computers, that the source account balance exceeds the source account maximum balance; determining, by the one or more transaction management computers, an excess amount based at least in part upon the source account balance and the source account maximum balance; accessing, by the one or more transaction management computers, the one or more databases to obtain depository account information for a depository account held at a depository institution, the depository account information comprising at least a depository account address; generating, by the one or more transaction management computers, electronic transaction instructions for a transfer of at least the excess amount from the source account to the depository account; providing, by the one or more transaction management computers to the source institution computer system via a source account transaction portal of the source institution computer system, the electronic transaction instructions causing the source institution computer system to execute the transfer; generating, by the one or more transaction management computers, an electronic notification of the transfer; and transmitting, by the one or more transaction management computers to the client device, the electronic notification of the transfer.

In embodiments, a method for performing deposit sweep transactions that bypass source and/or destination institution technological cooperation can comprise transmitting, from a client device associated with a client to a transaction management computer system comprising one or more computers, client access credentials associated with a transaction management account; receiving, at the client device from the transaction management computer system, machine-readable instructions to render an account information graphical user interface; receiving, at the client device from a user input device, source account access information for a source account of the client, the source account held at a source institution and the source account access information comprising source account identifying information and source account authentication information; transmitting, from the client device to the transaction management computer system via the account information graphical user interface, the source account access information; accessing, by the client device, a source account transaction portal of a source institution computer system associated with the source institution, the source account transaction portal comprising transaction parameter options for transactions from the source account; transmitting, by the client device to the source institution computer system via the source account transaction portal, electronic transaction instructions comprising transaction parameters; receiving, at the client device from the transaction management computer system, a first electronic notification of a proposed sweep transfer from a deposit account associated with the client to the source account, the transaction management computer system having monitored the source account using the source account authentication information to access a source account information portal of the source institution computer system and having determined a deficiency of funds in the source account based at least in part upon pending order information obtained via the source account information portal; transmitting, from the client device to the transaction management computer system, an electronic authorization to perform the proposed sweep transfer; and receiving, at the client device from the transaction management computer system, a second electronic notification comprising an indication that the proposed sweep transfer was executed.

In embodiments, the method may further comprise receiving, at the client device from a user input device, depository account access information for a depository account of the client, the depository account held at a depository institution and the depository account access information comprising depository account identifying information and depository account authentication information; and transmitting, from the client device to the transaction management computer system via the account information graphical user interface, the depository account access information.

In embodiments, a system for performing deposit sweep transactions that bypass source and/or destination institution technological cooperation can comprise one or more processors and non-transitory computer-readable memory having stored thereon instructions to perform the steps of transmitting, from a client device associated with a client to a transaction management computer system comprising one or more computers, client access credentials associated with a transaction management account; receiving, at the client device from the transaction management computer system, machine-readable instructions to render an account information graphical user interface; receiving, at the client

device from a user input device, source account access information for a source account of the client, the source account held at a source institution and the source account access information comprising source account identifying information and source account authentication information; transmitting, from the client device to the transaction management computer system via the account information graphical user interface, the source account access information; accessing, by the client device, a source account transaction portal of a source institution computer system associated with the source institution, the source account transaction portal comprising transaction parameter options for transactions from the source account; transmitting, by the client device to the source institution computer system via the source account transaction portal, electronic transaction instructions comprising transaction parameters; receiving, at the client device from the transaction management computer system, a first electronic notification of a proposed sweep transfer from a deposit account associated with the client to the source account, the transaction management computer system having monitored the source account using the source account authentication information to access a source account information portal of the source institution computer system and having determined a deficiency of funds in the source account based at least in part upon pending order information obtained via the source account information portal; transmitting, from the client device to the transaction management computer system, an electronic authorization to perform the proposed sweep transfer; and receiving, at the client device from the transaction management computer system, a second electronic notification comprising an indication that the proposed sweep transfer was executed.

In embodiments, a method of performing a deposit sweep transaction with customer control can comprise receiving, at a deposit sweep computer system comprising one or more computers, a deposit sweep file for a deposit sweep program, the deposit sweep file comprising transaction information; determining, by the deposit sweep computer system based at least in part upon the transaction information, allocations of funds for a plurality of customers, the allocations comprising identifications for each respective customer of one or more respective destination depository institutions and respective amounts to allocate to each respective destination depository institution; determining, by the deposit sweep computer system, for a first respective customer that at least one of the one or more respective destination depository institutions is a different destination depository institution for the first respective customer, the different destination depository institution not currently holding customer funds for the deposit sweep program for the first respective customer; generating, by the deposit sweep computer system, first machine-readable instructions to render a destination institution management graphical user interface comprising a different destination depository institution notification indicating that at least a portion of the customer funds are allocated to the different destination depository institution and further comprising a graphical accept option to approve the allocation and a graphical reject option to reject the allocation; providing, by the deposit sweep computer system to a client device, the first machine-readable instructions, causing the client device to activate an interface application to render the destination institution management graphical user interface on a display screen operatively connected to the client device; receiving, at the deposit sweep computer system from the client device, an approval of the allocation via the graphical accept option of the destination institution management graphical user interface; and executing, by the deposit sweep computer system, the allocations of funds.

In embodiments, the transaction information may comprise debits, credits, and/or balance information associated with a client account, and/or net credits, net debits information associated with a client account.

In embodiments, the step of determining, by the deposit sweep computer system, for the first respective customer that at least one of the one or more respective destination depository institutions is a different destination depository institution can comprise determining that the different destination depository institution does not hold customer funds in non-program accounts at the different destination depository institution.

In embodiments, the different destination depository institution notification may comprise an indication of the amount of funds allocated to the different destination depository institution for the first respective customer.

In embodiments, the destination institution management graphical user interface may comprise a transfer amount input element by which a user may input a maximum amount of funds permitted to be allocated to the different destination depository institution. The method may further comprise receiving, at the deposit sweep computer system from the client device along with the approval of the allocation, a maximum transfer amount via the transfer amount input element of the destination institution management graphical user interface; and determining, an updated allocation of funds based at least in part upon the maximum transfer amount, wherein executing, by the deposit sweep computer system, the allocations of funds comprises executing the updated allocation of funds.

In embodiments, the method may further comprise storing, by the deposit sweep computer system in one or more databases comprising non-transitory computer-readable memory, an indication of the approval of the allocation, the indication comprising an identification of the different destination depository institution.

In embodiments, the method may further comprise prior to executing the allocations of funds, determining, by the deposit sweep computer system, for a second respective customer that at least one of the one or more respective destination depository institutions is a respective different destination depository institution for the second respective customer, the respective different destination depository institution not currently holding customer funds for the deposit sweep program for the second respective customer; generating, by the deposit sweep computer system, second machine-readable instructions to render a respective destination institution management graphical user interface comprising a respective different destination depository institution notification indicating that at least a portion of the customer funds of the second respective customer are allocated to the respective different destination depository institution and further comprising a respective graphical accept option to approve the allocation and a respective graphical reject option to reject the allocation; providing, by the deposit sweep computer system to a second client device associated with the second respective customer, the second machine-readable instructions, causing the second client device to activate a respective interface application to render the respective destination institution management graphical user interface on a respective display screen operatively connected to the second client device; receiving, at the deposit sweep computer system from the second client device, a respective approval of the allocation via the respective graphical accept option of the respective desti-

nation institution management graphical user interface; and executing, by the deposit sweep computer system, the allocations of funds.

In embodiments, a system for performing a deposit sweep transaction with customer control can comprise one or more processors and non-transitory computer-readable memory having stored thereon instructions to perform the steps of receiving, at a deposit sweep computer system comprising one or more computers, a deposit sweep file for a deposit sweep program, the deposit sweep file comprising transaction information; determining, by the deposit sweep computer system based at least in part upon the transaction information, allocations of funds for a plurality of customers, the allocations comprising identifications for each respective customer of one or more respective destination depository institutions and respective amounts to allocate to each respective destination depository institution; determining, by the deposit sweep computer system, for a first respective customer that at least one of the one or more respective destination depository institutions is a different destination depository institution for the first respective customer, the different destination depository institution not currently holding customer funds for the deposit sweep program for the first respective customer; generating, by the deposit sweep computer system, first machine-readable instructions to render a destination institution management graphical user interface comprising a different destination depository institution notification indicating that at least a portion of the customer funds are allocated to the different destination depository institution and further comprising a graphical accept option to approve the allocation and a graphical reject option to reject the allocation; providing, by the deposit sweep computer system to a client device, the first machine-readable instructions, causing the client device to activate an interface application to render the destination institution management graphical user interface on a display screen operatively connected to the client device; receiving, at the deposit sweep computer system from the client device, an approval of the allocation via the graphical accept option of the destination institution management graphical user interface; and executing, by the deposit sweep computer system, the allocations of funds.

In embodiments, a client device, which may be a mobile device such as a mobile phone, may comprise one or more processors and non-transitory computer-readable memory having stored thereon computer-readable instructions to perform the steps of receiving, at client device associated with a first respective customer from a deposit sweep computer system, first machine-readable instructions to render a destination institution management graphical user interface comprising first display data comprising a different destination depository institution notification indicating that at least a portion of the customer funds are allocated to a different destination depository institution not currently holding funds of the first respective customer, the destination institution management graphical user interface further comprising a graphical accept option to approve the allocation of funds and a graphical reject option to reject the allocation; activating, by the client device an interface application to render the destination institution management graphical user interface on a display screen operatively connected to the client device; receiving, at the client device via an input device, a user selection of the graphical accept option; transmitting, from the client device to the deposit sweep computer system, an electronic approval of the allocation corresponding to the user selection of the graphical reject option; and receiving, at the client device, an electronic notification of an execution of the allocation of funds.

In embodiments, a method of performing a deposit sweep transaction with customer control can comprise receiving, at a deposit sweep computer system comprising one or more computers, a deposit sweep file for a deposit sweep program, the deposit sweep file comprising transaction information; determining, by the deposit sweep computer system based at least in part upon the transaction information, allocations of funds for a plurality of customers, the allocations comprising identifications for each respective customer of one or more respective destination depository institutions and respective amounts to allocate to each respective destination depository institution; determining, by the deposit sweep computer system, for a first respective customer that at least one of the one or more respective destination depository institutions is a different destination depository institution for the first respective customer, the different destination depository institution not currently holding customer funds for the deposit sweep program for the first respective customer; generating, by the deposit sweep computer system, first machine-readable instructions to render a destination institution management graphical user interface comprising first display data comprising a different destination depository institution notification indicating that at least a portion of the customer funds are allocated to the different destination depository institution and further comprising a graphical accept option to approve the allocation and a graphical reject option to reject the allocation; providing, by the deposit sweep computer system to a client device, the first machine-readable instructions, causing the client device to activate an interface application to render the destination institution management graphical user interface on a display screen operatively connected to the client device; receiving, at the deposit sweep computer system from the client device, a rejection of the allocation via the graphical reject option of the destination institution management graphical user interface; generating, by the deposit sweep computer system, second machine-readable instructions to render an updated destination institution management graphical user interface comprising second display data, the second display data comprising one or more alternate depository institution selection options; providing, by the deposit sweep computer system to the client device, the second machine-readable instructions, causing the client device to render the updated destination institution management graphical user interface; receiving, at the deposit sweep computer system from the client device via the updated destination institution management graphical user interface, an alternate depository institution selection comprising a selection of at least one of the alternate depository institution selection options; determining, by the deposit sweep computer system, an updated allocation of funds based at least in part upon the alternate depository institution selection; and executing, by the deposit sweep computer system, the updated allocations of funds.

In embodiments, the transaction information may comprise debits, credits, and/or balance information associated with a client account, and/or net credits, net debits information associated with a client account.

In embodiments, determining, by the deposit sweep computer system, for the first respective customer that at least one of the one or more respective destination depository institutions is a different destination depository institution may comprise determining that the different destination depository institution does not have an existing account for the first respective customer.

In embodiments, the different destination depository institution notification may comprise an indication of the amount of funds allocated to the different destination depository institution for the first respective customer.

In embodiments, the destination institution management graphical user interface may comprise respective maximum transfer amount input elements associated with each of the one or more alternate depository institution selection options by which a user may input respective maximum amounts of funds permitted to be allocated to the respective alternate depository institutions.

In embodiments, the method may further comprise storing, by the deposit sweep computer system in one or more databases comprising non-transitory computer-readable memory, an indication of the rejection of the allocation, the indication comprising an identification of the different destination depository institution. In embodiments, the method may further comprise storing, by the deposit sweep computer system in one or more databases comprising non-transitory computer-readable memory, an indication of the alternate depository institution selection, the indication comprising an identification of the alternate depository institution associated with the alternate depository institution selection.

In embodiments, a system for performing a deposit sweep transaction with customer control can comprise one or more processors and non-transitory computer-readable memory having stored thereon instructions to perform the steps of receiving, at a deposit sweep computer system comprising one or more computers, a deposit sweep file for a deposit sweep program, the deposit sweep file comprising transaction information; determining, by the deposit sweep computer system based at least in part upon the transaction information, allocations of funds for a plurality of customers, the allocations comprising identifications for each respective customer of one or more respective destination depository institutions and respective amounts to allocate to each respective destination depository institution; determining, by the deposit sweep computer system, for a first respective customer that at least one of the one or more respective destination depository institutions is a different destination depository institution for the first respective customer, the different destination depository institution not currently holding customer funds for the deposit sweep program for the first respective customer; generating, by the deposit sweep computer system, first machine-readable instructions to render a destination institution management graphical user interface comprising first display data comprising a different destination depository institution notification indicating that at least a portion of the customer funds are allocated to the different destination depository institution and further comprising a graphical accept option to approve the allocation and a graphical reject option to reject the allocation; providing, by the deposit sweep computer system to a client device, the first machine-readable instructions, causing the client device to activate an interface application to render the destination institution management graphical user interface on a display screen operatively connected to the client device; receiving, at the deposit sweep computer system from the client device, a rejection of the allocation via the graphical reject option of the destination institution management graphical user interface; generating, by the deposit sweep computer system, second machine-readable instructions to render an updated destination institution management graphical user interface comprising second display data, the second display data comprising one or more alternate depository institution selection options; providing, by the deposit sweep computer system to the client device, the second machine-readable instructions, causing the client device to render the updated destination institution management graphical user interface; receiving, at the deposit sweep computer system from the client device via the updated destination institution management graphical user interface, an alternate depository institution selection comprising a selection of at least one of the alternate depository institution selection options; determining, by the deposit sweep computer system, an updated allocation of funds based at least in part upon the alternate depository institution selection; and executing, by the deposit sweep computer system, the updated allocations of funds.

In embodiments, a client device, which may be a mobile device such as a mobile phone, may comprise one or more processors and non-transitory computer-readable memory having stored thereon computer-readable instructions to perform the steps of receiving, at client device associated with a first respective customer from a deposit sweep computer system, first machine-readable instructions to render a destination institution management graphical user interface comprising first display data comprising a different destination depository institution notification indicating that at least a portion of the customer funds are allocated to a different destination depository institution not currently holding funds of the first respective customer, the destination institution management graphical user interface further comprising a graphical accept option to approve the allocation and a graphical reject option to reject the allocation; activating, by the client device an interface application to render the destination institution management graphical user interface on a display screen operatively connected to the client device; receiving, at the client device via an input device, a user selection of the graphical reject option; transmitting, from the client device to the deposit sweep computer system, an electronic rejection of the allocation corresponding to the user selection of the graphical reject option; receiving, at the client device from the deposit sweep computer system, second machine-readable instructions to render an updated destination institution management graphical user interface comprising second display data, the second display data comprising one or more alternate depository institution selection options; rendering, by the client device the updated destination institution management graphical user interface on the display screen; receiving, at the client device via an input device, an alternate depository institution selection comprising a user selection of at least one of the alternate depository institution selection options; transmitting, from the client device to the deposit sweep computer system, the alternate depository institution selection; receiving, at the client device, an electronic notification of an updated allocation of funds, wherein the allocation does not allocate funds to the different destination depository institution and wherein the allocation allocates funds to an alternate depository institution associated with the alternate depository institution selection.

In embodiments, a method of performing a deposit sweep transaction with customer control can comprise receiving, at a deposit sweep computer system comprising one or more computers, a deposit sweep file for a deposit sweep program, the deposit sweep file comprising transaction information; determining, by the deposit sweep computer system based at least in part upon the transaction information, first allocations of funds for a plurality of customers, the first allocations comprising for each respective customer identifications of one or more respective destination depository institutions and respective amounts to allocate to each

respective destination depository institution; determining, by the deposit sweep computer system, for a first subset of the plurality of customers that for each respective customer of the first subset of the plurality of customers at least one of the respective destination depository institutions is a respective different destination depository institution, the respective different destination depository institution not currently holding funds of the respective customer for the deposit sweep program; generating, by the deposit sweep computer system, respective first machine-readable instructions to render respective destination institution management graphical user interfaces each comprising respective first display data comprising a different destination depository institution notification indicating that at least a portion of the funds of the respective customer are allocated to the respective different destination depository institution and further comprising a respective graphical accept option to approve the respective allocation and a respective graphical reject option to reject the respective allocation; providing, by the deposit sweep computer system to a plurality of respective client devices each associated with one of the respective customers of the first subset of the plurality of customers, the respective first computer-readable instructions causing each respective client device to activate a respective interface application to render the respective destination institution management graphical user interface on a respective display screen operatively connected to the respective client device; receiving, at the deposit sweep computer system from a first subset of the respective client devices within a predefined period of time, respective approvals of the respective different destination depository institutions via respective selections of the respective accept options; receiving, at the deposit sweep computer system from a second subset of the respective client devices within the predefined period of time, respective rejections of the respective different destination depository institutions via respective selections of the respective reject options; determining, by the deposit sweep computer system, second allocations of funds for the plurality of customers, the second allocations based at least in part upon the transaction information, the first allocations, and the respective rejections; and executing, by the deposit sweep computer system, the second allocations of funds.

In embodiments, the method may further comprise, prior to determining the second allocations of funds, determining, by the deposit sweep computer system, a third subset of the respective client devices comprising those of the plurality of respective client devices not included in the first subset or the second subset of the respective client devices; and determining, by the deposit sweep computer system, respective approvals of the respective different destination depository institutions for each respective client device of the third subset of the respective client devices.

In embodiments, at least one of the respective rejections may comprise a selection of one or more alternate depository institutions.

In embodiments, executing the second allocations of funds may comprise updating an electronic ledger.

In embodiments, the method may further comprise, prior to determining the second allocations of funds, generating, by the deposit sweep computer system for each of the second subset of the respective client devices, respective second machine-readable instructions to render respective updated destination institution management graphical user interfaces each comprising respective second display data comprising one or more respective alternate depository institution selection options; providing, by the deposit sweep computer system to the second subset of the respective client devices, the respective second machine-readable instructions, causing each respective client device to render the respective updated destination institution management graphical user interface; and receiving, at the deposit sweep computer system from one or more of the second subset of the respective client devices via the respective updated destination institution management graphical user interfaces, respective alternate depository institution selections comprising respective selections of at least one of the respective alternate depository institution selection options, wherein determining, by the deposit sweep computer system, second allocations of funds for the plurality of customers comprises determining the second allocations based at least in part upon the transaction information, the first allocations, and the respective alternate depository institution selections.

In embodiments, the second allocations of funds do not include allocations of funds for the plurality of customers to the respective different destination depository institutions associated with the respective rejections.

In embodiments, a system for performing a deposit sweep transaction with customer control can comprise one or more processors and non-transitory computer-readable memory having stored thereon instructions to perform the steps of receiving, at a deposit sweep computer system comprising one or more computers, a deposit sweep file for a deposit sweep program, the deposit sweep file comprising transaction information; determining, by the deposit sweep computer system based at least in part upon the transaction information, first allocations of funds for a plurality of customers, the first allocations comprising for each respective customer identifications of one or more respective destination depository institutions and respective amounts to allocate to each respective destination depository institution; determining, by the deposit sweep computer system, for a first subset of the plurality of customers that for each respective customer of the first subset of the plurality of customers at least one of the respective destination depository institutions is a respective different destination depository institution, the respective different destination depository institution not currently holding funds of the respective customer for the deposit sweep program; generating, by the deposit sweep computer system, respective first machine-readable instructions to render respective destination institution management graphical user interfaces each comprising respective first display data comprising a different destination depository institution notification indicating that at least a portion of the funds of the respective customer are allocated to the respective different destination depository institution and further comprising a respective graphical accept option to approve the respective allocation and a respective graphical reject option to reject the respective allocation; providing, by the deposit sweep computer system to a plurality of respective client devices each associated with one of the respective customers of the first subset of the plurality of customers, the respective first computer-readable instructions causing each respective client device to activate a respective interface application to render the respective destination institution management graphical user interface on a respective display screen operatively connected to the respective client device; receiving, at the deposit sweep computer system from a first subset of the respective client devices within a predefined period of time, respective approvals of the respective different destination depository institutions via respective selections of the respective accept options; receiving, at the deposit sweep computer system from a second subset of the respective

client devices within the predefined period of time, respective rejections of the respective different destination depository institutions via respective selections of the respective reject options; determining, by the deposit sweep computer system, second allocations of funds for the plurality of customers, the second allocations based at least in part upon the transaction information, the first allocations, and the respective rejections; and executing, by the deposit sweep computer system, the second allocations of funds.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and related objects, features, and advantages of the present invention, will be more fully understood by reference to the following detailed description of the exemplary embodiments of the present invention, when taken in conjunction with the following exemplary figures, wherein:

FIG. **1**A is a schematic block diagram representing institutions, clients and a transaction management system in accordance with exemplary embodiments of the present invention.

FIG. **1**B is similar to FIG. **1**A, except that the destination institutions **140** have been substituted for the depository institutions in accordance with exemplary embodiments of the present invention.

FIG. **1**C is a schematic block diagram representing the computer systems for the institutions, clients and the transaction management system connecting via one or more communications networks in accordance with exemplary embodiments of the present invention.

FIG. **2** is schematic block diagram representing components of a client device in accordance with exemplary embodiments of the present invention.

FIG. **3** is a schematic block diagram representing embodiments of a transaction management system in accordance with exemplary embodiments of the present invention.

FIG. **4** is a flow chart of embodiments of system configuration operations with a client in accordance with exemplary embodiments of the present invention.

FIG. **5**A is flow chart of embodiments of the invention for processing account transactions in accordance with exemplary embodiments of the present invention.

FIG. **5**B is flow chart of further embodiments of the invention for processing account transactions in accordance with exemplary embodiments of the present invention.

FIG. **5**C is flow chart of yet further embodiments of the invention using push operations for processing account transactions in accordance with exemplary embodiments of the present invention.

FIG. **5**D is flow chart of embodiments of the invention using retrieval operations for processing account transactions in accordance with exemplary embodiments of the present invention.

FIGS. **5**E-**1**-**5**E-**3** are flow charts of an exemplary process for performing a bypass deposit sweep to fund a source account in accordance with embodiments of the present invention.

FIG. **6**A is flow chart of embodiments of the invention for processing excess funds in accordance with exemplary embodiments of the present invention.

FIG. **6**B is flow chart of further embodiments of the invention for processing excess funds using push operations in accordance with exemplary embodiments of the present invention.

FIG. **6**C is flow chart of embodiments of the invention for processing excess funds using retrieval operations in accordance with exemplary embodiments of the present invention.

FIGS. **6**D-**1**-**6**D-**2** are flow charts of an exemplary process for performing a bypass deposit sweep to maintain a source account maximum balance in accordance with embodiments of the present invention.

FIG. **6**E is a flow chart of an exemplary process for analyzing a destination account balance in accordance with exemplary embodiments of the present invention.

FIG. **7**A is a schematic diagram of embodiments of a client interface screen for accessing client source accounts in accordance with exemplary embodiments of the present invention.

FIG. **7**B is a schematic diagram of embodiments of a client interface screen for obtaining client authentication data for accessing client source accounts in accordance with exemplary embodiments of the present invention.

FIG. **7**C is a schematic diagram of embodiments of a client interface screen for accessing client destination accounts in accordance with exemplary embodiments of the present invention.

FIG. **7**D is a schematic diagram of embodiments of a client interface screen for obtaining client authentication data for accessing client destination accounts in accordance with exemplary embodiments of the present invention.

FIG. **8**A is a schematic diagram of embodiments of a client interface screen for a client home page that lists recent transaction history for client source accounts and facilitates access to client source accounts and destination accounts and transaction rules and the client TMS account in accordance with exemplary embodiments of the present invention.

FIG. **8**B is a schematic diagram of embodiments of a client interface screen for viewing a listing of the client's source accounts, with an Add Source Account button, a View Account button, and an Edit Account button in accordance with exemplary embodiments of the present invention.

FIG. **8**C is a schematic diagram of embodiments of a client interface screen that may be presented when the Add Source Account button is activated for adding a new client source account in accordance with exemplary embodiments of the present invention.

FIG. **8**D is a schematic diagram of embodiments of a client interface screen that may be presented when the Edit Account button is activated for viewing and editing the data for a particular one of the client's source accounts in accordance with exemplary embodiments of the present invention.

FIG. **8**E is a schematic diagram of embodiments of a client interface screen for viewing a listing of the client's destination accounts, with an Add Source Account button, a View Account button, and an Edit Account button in accordance with exemplary embodiments of the present invention.

FIG. **8**F is a schematic diagram of embodiments of an interface screen for editing transaction settings in accordance with exemplary embodiments of the present invention.

FIGS. **9**A-C are screen shots of transaction notifications in accordance with exemplary embodiments of the present invention.

FIGS. **10**A-C are schematic diagrams of secure authentication system architectures in accordance with exemplary embodiments of the present invention.

FIG. **11**A is a schematic diagram of data flow among components of a client device and steps performed by each component in a secure data authentication process associated with deposit sweep transfer operations in accordance with exemplary embodiments of the present invention.

FIGS. **11**B-D are flow charts of exemplary processes for performing deposit sweep operations securely in accordance with exemplary embodiments of the present invention.

FIGS. **12**A-D illustrate exemplary selection of a core point on a digital biometric image for biometric feature extraction in accordance with exemplary embodiments of the present invention.

FIGS. **13**A-**13**C-**2** are flow chart of processes for providing customer control in an automated deposit sweep transaction in accordance with exemplary embodiments of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS

The present invention generally relates to various technological improvements in systems, methods and program products used to transfer funds between trading accounts and interest bearing accounts.

The following description is presented to enable a person of ordinary skill in the art to make and use the invention, and is provided in the context of particular applications and their requirements. Various modifications to the embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments and applications without departing from the spirit and scope of the invention. In the following description, numerous details are set forth for the purpose of explanation. However, one of ordinary skill in the art will realize that the invention may be practiced without the use of these specific details. In other instances, well-known structures and devices are shown in block diagram form in order not to obscure the description of the invention with unnecessary detail. Thus, the present invention is not intended to be limited to the embodiments shown, but is to be accorded the widest scope consistent with the principles and features disclosed herein.

The automatic fund transfer programs of clearing firm computers currently control transfers between brokerage firms and cash management products, e.g., money market mutual funds, FDIC insured cash management products held in banks and other depository institution, and other cash management products. Note that a clearing firm or all or part of its functionality may be implemented in an independent entity, or in a source institution such as a broker dealer, or may be implemented in a source institution such as a program bank or other depository entity, or may be affiliated therewith. In particular, the automatic transfer functions of clearing firm computers, such as sweep programs for example, in many instances control coverage of the settlement of trades on behalf of a client in investment products. In embodiments, the invention provides a technical solution to enable an individual client to manage and perform fund transfer operations such as sweep transactions while bypassing automatic fund transfer functions, if any, in clearing firm computers and/or source institution computers and/or destination institution computers to eliminate the electronic processing delay and expense attendant thereto and, in embodiments, clearing firm and/or source institution and/or destination institution computer control. The technical problem solved is a unique problem caused by the shift of buy and sell transactions from the manual realm to computer control, so that an individual client no longer can directly control its buy and sell transactions. Note that in embodiments of the invention, a transfer function at a clearing firm computer or source or destination computer may be accessed by or on behalf of the client to make fund transfers, but this access will not be as part of an automatic transfer function of those entities. Thus, the active participation of the clearing firm and/or the source institution and/or the destination institution is bypassed though technological embodiments of the present invention.

Referring to FIG. **1**A, there is shown a schematic block diagram representing institutions, clients and a transaction management system. The individual clients are represented by the client blocks **110-1**, **110-2**, . . . **110**-N. The transaction management system (TMS) for performing the operations necessary to the automatic fund transfer programs of clearing firm and/or source institution and/or destination institution computers is represented by the block **120**. The TMS **120** may be a deposit sweep computer system. The TMS **120** may be configured to access source and/or destination account information, e.g., using user credentials. In embodiments, a plurality of client accounts **104** may be associated with a single client **110**.

Source institutions, e.g., various broker dealers which may originate buy and sell orders, are represented by the blocks **100-1**, **100-2**, . . . **100**-M. Each of the source institutions is shown with a control operating account **102**, which, in embodiments, may be an optional account. Each of the source institutions **100** is also shown with multiple different client accounts **104**, e.g., for the client suffices **1**, **2**, . . . N. Source institutions may be banks, credit unions, other types of depository institutions, registered investment advisors, broker dealers, asset managers, trust companies, retirement programs, other financial institutions or intermediaries, to name a few. Typically, the source institutions are the institutions that interact with the clients that are placing or authorizing the respective clients' funds to go into and be managed by the system. Note that a source institution can be a clearing institution for one or more other source institutions or an intermediary for other source institutions. Source institutions can hold source accounts relating to securities and/or bonds, including trading thereof.

Depository institutions, e.g., destination institutions, are represented by the blocks **130-1**, **130-2**, . . . **130**-P. Depository institutions can be any institution that is authorized to accept deposits and issue certificates of deposit. This would include state and national banks, state and federal savings banks, savings and loan associations, credit unions, and probably some industrial loan companies, depending on current law. Most but not necessarily all, would have government backed-insurance, such as Federal Deposit Insurance Corporation (FDIC) insurance, insurance for credit unions, or state insurance. Depository institutions can include banks holding bank accounts or institutions providing time deposit instruments, negotiable order of withdrawal (NOW) accounts, money market deposit accounts (MMDAs), aggregated MMDAs, demand deposit accounts (DDAs), aggregated DDAs, and/or certificates of deposit (CDs), to name a few. Each of the depository institutions is shown with an aggregated demand deposit account **132** holding the funds of multiple clients, and an aggregated money market deposit account **134** holding the funds of multiple clients. However, in embodiments, there may be a separate DDA and MMDA for each of multiple clients. In embodiments, a source institution may also be a depository institution and vice versa. Depository institutions may hold omnibus accounts and/or individual customer accounts. In embodiments, the source and deposit functions may be

maintained in separate institutions. The entities shown may be associated with one or more computer systems and/or user electronic devices, as described herein with respect to FIG. **1**C.

Depending on the particular deposit sweep transaction being executed, a source institution or a destination institution may be trading institution, such as a broker-dealer or brokerage institution, or a depository institution, such as a bank or other institution providing interest-bearing accounts (insured or not insured) or other investment accounts (e.g., money fund, exchange traded fund, etc.). Other destination institutions can include, by way of example, institutions holding, managing, and/or providing cash management vehicles and/or cash management accounts, such as DDAs, MMDAs, NOW accounts, stable value funds, credit interest programs, to name a few. Thus, a sweep transaction may involve an allocation, transfer, or other flow of funds from a source institution to a destination institution or vice versa from the destination institution to the source institution. In embodiments, a sweep transaction may involve an allocation, transfer, or other flow of funds from a first destination institution to a second destination institution.

While certain systems, methods, and program products described herein refer to embodiments involving deposit sweep transactions, it will be understood by one of skill in the art that such systems, methods, and program products may apply to other sweep transactions, such as cash sweep transactions, which may include money fund sweeps, stable value fund sweeps, capital investment plan (CIP) sweeps, or sweeps from or to any of the institutions holding cash management vehicles and/or cash management accounts as described herein, and the present invention extends to such embodiments.

FIG. **1**B is similar to FIG. **1**A, except that the destination institutions **140** have been substituted for the deposit institutions. The destination institutions may include non-FDIC insured investment vehicles, such as money market mutual funds, other kinds of mutual funds, exchange traded funds (ETF), exchange traded notes (ETN), stable value funds, index funds, treasury bonds, stocks, bonds, notes, to name a few. Destination institutions can include institutions holding, managing, and/or providing cash management vehicles and/or cash management accounts, such as DDAs, MMDAs, NOW accounts, credit interest programs, to name a few. In preferred embodiments, investment vehicles should be liquid or substantially liquid, to name a few.

FIG. **1**C is a schematic block diagram representing the computer systems and/or user electronic devices for the institutions, clients and the transaction management system connecting via one or more electronic communications networks **50**. An electronic communications network **50** may be a data network, such as the Internet, a wide area network, and/or a local area network, to name a few. The computer systems for the source institutions are represented by the blocks **106**. The computer systems for the users are represented by the blocks **112**. The computer systems for the destination institutions are represented by the blocks **146**. The various computer systems may comprise one or more computers or user electronic devices. The computers and user electronic devices may comprise one or more processors, non-transitory computer-readable memory, communications portals, input devices (e.g., keyboard, mouse, touch screen, microphone, camera, scanner, to name a few) and output devices (e.g., display devices, speakers, to name a few). Communications portals can comprise hardware and/or software for transmitting, receiving, retrieving, and/or otherwise obtaining data, such as data packets or streams, according to one or more protocols, using wired and/or wireless communications. In embodiments, communications portals can include one or more communications chipsets, such as a GSM chipset, CDMA chipset, LTE chipset, Wi-Fi chipset, Bluetooth chipset, to name a few, and/or combinations thereof. Wired connections may be adapted for use with cable, telephone, fiber (such as Hybrid Fiber Coaxial), xDSL, to name a few, and wired connections may use coaxial cable, fiber, copper wire (such as twisted pair copper wire), and/or combinations thereof, to name a few. Wired connections may be provided through telephone ports, Ethernet ports, USB ports, and/or other data ports. Wireless connections may include cellular or cellular data connections adapted for use with one or more cellular communications protocols (e.g., digital cellular, PCS, CDPD, GPRS, EDGE, CDMA2000, 1×RTT, Ev-DO, HSPA, UMTS, 3G, 4G, 5G, and/or LTE, to name a few), and/or may include other wireless connections for use with wireless protocols such as Bluetooth, Bluetooth Low Energy, Wi-Fi, radio, satellite, and/or infrared connections, to name a few. Hardware for such communications portals can further include Ethernet interfaces (e.g., supporting a TCP/IP stack), X.25 interfaces, T1 interfaces, and/or antennas, to name a few.

Referring to FIG. **2**, there is shown a schematic block diagram representing components of a client device **112**. In embodiments, the client device **112** may comprise a user electronic device, such as a computer, laptop computer, tablet computer, mobile phone, smart phone, PDA, web-enabled television, and/or wearable electronic device (e.g., watch and/or glasses), to name a few. In embodiments, the client device may comprise one or more processors **202**, communications portals **204**, display devices **206**, e.g., an LCD display, and input devices **208**, e.g., a keyboard, mouse, touch screen, etc. The client device **112** can further include non-transitory computer-readable memory. Data may be stored in one or more database stored on the computer-readable memory, and particular software modules may be stored on the computer-readable memory. Such modules may run or be configured to run on the one or more processors **202**. Exemplary data and modules are described herein.

In embodiments, the client device **112** may comprise electronic data storage **212** for TMS account data. The TMS account data may comprise in embodiments, the user's information for the transaction management system **120**, e.g., login credentials (username and/or password), contact information (email address, phone number, address), billing information (credit card information, bank account information), transaction rules, and/or notification settings, to name a few.

In embodiments, the client device **112** may comprise electronic data storage **214** for client source account authentication data. In embodiments, the client source account authentication data may comprise the user's information for accessing each account at the one or more source institutions of the client (e.g., account number, authentication information such as account login credentials, multi-factor authentication data, security questions, etc.). In embodiments, the client source account authentication data may also include information identifying the various source institutions. This may or may not be present on the client device. For example, in embodiments, such data may be stored at the TMS **120** instead of at the client device **112**.

In embodiments, the client device **112** may comprise electronic data storage **216** for client destination account authentication data. In embodiments, the client destination

account authentication data may comprise the user's information (e.g., login credentials, multi-factor authentication data, security questions) for accessing each account at one or more of the destination institutions or funds, or other destination institutions. The client destination account authentication data may also include information identifying the various destination accounts (destination institution or fund+account identifier, e.g. account number). This may or may not be present on the client device.

In embodiments, the client device **112** may store other data, such as transaction logs and/or account balance data for one or more accounts. In embodiments, the client device **112** may store account balance retrieval history data, which may identify one or more times associated with retrievals of account balance information.

In embodiments, the client device **112** may comprise a TMS Account Authentication Module **232** for logging into the user's TMS account (e.g., to manage settings, view history of fund transactions, to add accounts, etc.). In embodiments, this Module **232** may be configured to access the TMS Account Data **212** and the requisite authentication data to log in to the TMS **120**. Screens for managing settings, viewing a history of transactions, etc., are shown and will be discussed in relation to FIGS. **8**A-**8**F.

In embodiments, the client device **112** may comprise a TMS Rules electronic module **234** for creating and/or managing transaction rules (e.g., source/deposit account monitoring frequency, accounts to monitor, limits for cash transactions, account minimums and account maximums, to name a few). In embodiments, default electronic rules may be provided by the TMS, which may be stored at the client device **112** and/or stored at the TMS **120**.

In embodiments, the client device **112** may comprise a data push module **236** configured to be triggered by an event, e.g., the receipt at the client device **112**, via the one or more electronic networks **50** and the communications portal **204**, of new balance data for accounts held in the client's source institutions **100**, and/or new balance data for accounts held in the destination institutions **130**, and/or may be triggered by the transmission of transaction data, e.g., buy and sell orders, or the receipt of this transaction data by the client device. In embodiments, this push module may be implemented using Web Socket technology, Java applets or other plug-ins, to name a few.

The client device **112** may include a graphical user interface (GUI) module **238**. A GUI module **238** may receive display data from one or more remote sources (e.g., computer servers) and/or may receive machine-readable instructions for generating a particular graphical user interface comprising display content. In embodiments, the GUI module **238** may generate the display data and/or activate a viewer application to render the graphical user interface. The GUI module **238** may update a GUI with new display data based at least in part upon data and/or instructions received, e.g., from a remote server, and/or in response to user inputs and/or time-based events (e.g., delayed actions) based at least in part upon pre-programmed or previously received instructions.

The client device **112** may include a security protocol module **240**, which may perform processes to encrypt electronic messages and/or apply digital signatures to electronic messages, as described herein. A security protocol module **240** may generate an asymmetric private key based at least in part upon an invariant biometric feature vector, which may be extracted from and/or derived at least from a biometric reading of a user (e.g., a fingerprint).

Referring to FIG. **3**, there is shown a schematic block diagram representing embodiments of the transaction management system (TMS) **120**. The TMS **120** may be a computer system comprising one or more computers. The TMS **120** may comprise one or more processors **302**, communications portals **304**, display devices **306**, and/or input devices **308**. The TMS **120** can further include non-transitory computer-readable memory. Data may be stored in one or more database stored on the computer-readable memory, and particular software modules may be stored on the computer-readable memory. Such modules may run or be configured to run on the one or more processors **302**. Exemplary data and modules are described herein.

In embodiments, the TMS **120** may comprise electronic data storage **312** for TMS account data. In embodiments, the TMS account data may comprise the user's information for the transaction management system, such as login credentials (username and/or password), contact information (email address, phone number, address), billing information (credit card information, bank account information), and/or user preferences and/or settings. In embodiments, TMS account data **312** can include TMS transaction history data, which may identify one or more transactions (e.g., fund transfers) performed by the TMS.

In embodiments, the TMS **120** may comprise electronic data storage **314** for client source account authentication data. In embodiments, the client source account authentication data may comprise the user's information for accessing each account at the source institution (account number, authentication information, such as login credentials). It can also include information identifying the various source institutions.

In embodiments, the TMS **120** may comprise electronic data storage **316** for client destination account authentication data. In embodiments, the client destination account authentication data may comprise the user's information for accessing each account at the one or more destination institutions. The client destination account authentication data may also include information identifying the various destination institutions.

In embodiments, the TMS **120** may comprise storage **318** for client source account balance data. In embodiments, client source account balance data may comprise an amount of cash held in a respective source account, and in embodiments, may further include amounts of other financial instruments or commodities (shares of stock, mutual funds, bonds, etc.). In embodiments, this balance data may be obtained on the fly after new transaction data has been received or obtained. In embodiments, the balance data may be obtained periodically, e.g., every 6 hours, 4 pm each day, once a week, twice a day, to name a few.

In embodiments, the TMS **120** may comprise electronic data storage **320** for client destination account balance data for one or more client destination accounts in the same or in different institutions. In embodiments, the client destination account balance data may comprise an amount of cash or liquid financial vehicles (e.g., an MMDA balance) held in a respective destination account, and in embodiments, may further include amounts of other financial instruments or commodities (shares of stock, mutual funds, bonds, etc.) held in the institution. In embodiments, this balance data may be obtained on the fly after new transaction data has been received or obtained. In embodiments, the balance data may be obtained periodically. In embodiments, client destination account transaction data **320** can include transaction history data for one or more destination accounts.

In embodiments, the TMS **120** may comprise electronic data storage **322** for client source account transaction data **322**. In embodiments, the client source account transaction data may comprise pending order information for one or more trades, e.g., buy orders and/or sell orders. In embodiments, client source account transaction data **322** can include transaction history data for one or more source accounts.

In embodiments, the TMS **120** may comprise a TMS rules electronic storage **324** for storing electronic rules (e.g., user-specified and/or default rules) for performing various transactions. In embodiments, electronic transaction rules may be generated based at least in part upon user-specified and/or default rules. In embodiments, a user may set destination account balance limits that specify account balance limits (min or max limits), frequencies for performing cash transfer transactions (or other fund transfer transactions), and/or frequencies for determining account balances, to name a few.

In embodiments, the TMS **120** may further comprise a TMS account rules module **334** for generating and/or populating electronic transaction rules based at least in part upon user-specified rules and data and/or default rules. In embodiments, this module **334** may also trigger and/or execute such rules.

The TMS **120** may include a client source account balance retrieval module **336**. Such a module may obtain (e.g., retrieve and/or receive) source account balance data, which may comprise a numerical balance amount. In embodiments, a balance amount may have a corresponding timestamp (e.g., date and/or time). The source account balance retrieval module **336** may use client source account authentication data **314** to access one or more source accounts and obtain the source account balance data.

The TMS **120** may include a client destination account balance retrieval module **338**. Such a module may obtain (e.g., retrieve and/or receive) destination account balance data, which may comprise a numerical balance amount and may have a corresponding timestamp. The destination account balance retrieval module **338** may use client destination account authentication data **316** to access one or more destination accounts and obtain the destination account balance data.

In embodiments, the TMS **120** may further comprise a balance sufficiency module **340**. In embodiments, the balance sufficiency module may be configured to determine whether a source account balance (obtained from the electronic storage **318** or obtained on the fly) is sufficient to cover a pending net buy order, and/or to determine whether there is excess cash in the client source account. In embodiments, this module determination may comprise subtracting an amount for the net buy order from the client source account balance, and determining if the result is a positive amount, or a deficiency amount.

In embodiments, the TMS **120** may further comprise a transaction module **342**. In embodiments, the transaction module may be configured to generate electronic transaction instructions to move funds between institutions, and/or execute a movement of funds between institutions, e.g., fund movement from a source account held at a source institution to a destination account at a destination institution, or vice versa. In embodiments, the electronic transaction instructions and/or parameters may identify source and destination accounts, transaction amounts, and/or account credentials or a database pointer to electronically stored credentials to use for authorizing the transaction.

Referring to FIG. **4**, there is shown a flow chart of embodiments of system set-up operations with a client. Block S**402** represents a computer-implemented operation of receiving, at the transaction management system **120** from a client device **110**, source account access data comprising source account identifying information and corresponding source account authentication information, e.g., user ID and password.

Block S**404***a* represents a computer-implemented operation of receiving, at the transaction management system **120** from a client device **110**, destination account access data comprising destination account identifying information and corresponding destination account authentication information, e.g., user ID and password. In embodiments, in a step S**404***b*, the transaction management system may instead receive the destination account access data from a cash sweep, e.g., deposit sweep, administrator computer system or user device.

Block S**406** represents a computer-implemented operation of storing, by the transaction management system **120** in one or more databases **214**, **216**, the source account access data and the destination account access data.

Block S**408***a* represents a computer-implemented operation of receiving, at the transaction management system **120** from a client device **110**, transaction rules or data for implementing one or more transaction rules. In embodiments, in a step S**408***b*, such transaction rules or rules data may instead be received at the transaction management system from a deposit sweep administrator computer system or user device. Examples of such data to populate transaction rules comprise a source account minimum balance, a source account maximum balance, a source account target balance, a destination account minimum balance, an account balance monitoring frequency, a transaction monitoring frequency, e.g., every 30 seconds, every minute, every 10 minutes, etc., a default destination account for fund transfers from the source accounts, an order of destination institutions or other destination institutions for receiving deposits, and source-destination account links.

Block S**410** represents a computer-implemented operation of generating, at the transaction management system **120**, electronic transaction rules based at least in part upon the data received for implementing the one or more transaction rules.

Block S**412** represents a computer-implemented operation of storing, by the transaction management system in one or more databases, the generated electronic transaction rules.

In embodiments, the transaction management system **120** may receive updated transaction rule data and/or updated account access data (e.g., modifications to existing data, new data, and/or requests to remove existing data). The transaction management system **120** may generate and/or store new and/or modified electronic transaction rules based at least in part upon the received updated rule data and/or account access data.

The transaction management system may execute cash sweeps such as deposit sweeps from trading accounts to depository accounts or vice versa, without the technological cooperation of the institutions holding the accounts. In embodiments, the transaction management system may determine whether deposit sweep customers or other cash sweep customers hold other funds, e.g., non-program funds, at program banks and may determine allocations of funds accordingly, e.g., so as not to exceed maximum account balances. In embodiments, the system may determine not to allocate such a customer's funds to a bank that already holds funds of the customer.

In embodiments, the transaction management system may comprise cash sweep software running on a client device. The cash sweep software may comprise deposit sweep software. A user of the client device may execute cash sweep operations, such as deposit sweep operations, using the cash and/or deposit sweep software. Accordingly, a third-party deposit management entity may not be required.

As described herein, a transaction management computer system may determine a need for a sweep transaction, such as a deposit sweep transaction. Such a sweep transaction may be from a source account at a source institution to a depository account at a depository institution. A sweep transaction may also be from a depository account at a depository institution to a source account at a source institution. In other embodiments, a sweep transaction may comprise an allocation or reallocation of funds among a plurality of institutions, such as a plurality of depository institutions or a plurality of both source and depository institutions. In embodiments, such allocations may involve omnibus depository accounts at one or more depository institutions.

Sweep transactions may be triggered by transactions at and/or transaction data obtained from one or more transaction sources or source institutions. Source institutions can include broker-dealers, brokerage firms, card servicers, bill payment servicers, ACH debit and/or credit servicers, check payment or processing servicers, to name a few. Examples of types of transactions that may occur in a source institution and thus trigger an event can include credit and/or debit events against the customer account at the source institution. For example, clients may access their funds for deposits and withdrawals from various transaction sources. Thus, card servicers represent credit and debit card processing organizations and networks. Internet bill payment servicers represent service providers for bill payment, checks, and funds exchanges generally via the Internet (or other electronic or data networks). ACH debits and credits represents various direct deposit and withdrawal clearinghouse services. Check payment servicers represent debit and credit transactions generated by paper check processing. Source institutions can also be associated with transactions generated as a result of other payment vehicles (such as touch-tone bill payment). Accordingly, clients may access their agent-managed funds by credit and debit cards, for Internet transactions, by direct deposits and withdrawals, by checks, and by other payment and funds exchange vehicles. Transaction data may be obtained from any of these source institutions. In embodiments, respective user access credentials may be used, e.g., by a transaction management system, to access electronic portals at such source institutions to obtain account balanced and/or transaction information, such as order amounts and/or dates. In embodiments, a transaction management system may monitor respective accounts at the source institutions to determine when transactions have occurred or are scheduled to occur, as described herein. Monitoring such accounts can comprise accessing account information, such as by using user access credentials to access respective electronic portals (e.g., according to a monitoring frequency), obtaining account information (e.g., balance information, transaction information, to name a few), and/or assessing a date and/or time associated with a last update of the account information and or a date and/or time associated with placement of order or fulfillment of orders for one or more transactions. In embodiments, assessing the date and/or time can comprise comparing such date and/or time to a date and/or time associated with the last retrieval of account information to determine if the account information is new. In embodiments, monitoring can comprise comparing current balance amounts to previous balance amounts to determine whether a change in balance has occurred.

Sweep transactions may be triggered by account balances in either the source institution or depository institution reaching or exceeding a threshold amount (e.g., a monetary amount, such as a dollar amount). Such a threshold amount may represent a maximum account balance (e.g., a maximum permissible or desirable balance) or a minimum account balance (e.g., a minimum permissible or desirable balance), which balance limits may be determined by user preference, government regulation, insurance requirements (e.g., maximum insurable amounts for an account or institution, which may be measured per customer), and/or institution requirements (e.g., required minimum account balances to avoid incurring fees). Exceeding a threshold may comprise a balance or projected balance (e.g., a projected post-transaction balance for a pending transaction) rising above the threshold. In other embodiments, exceeding the threshold may comprise falling below the threshold.

A need for one or more sweep transactions may be determined automatically by a transaction management computer system, e.g., based at least in part upon the occurrence of the sweep transaction triggers described herein. In embodiments, sweep transactions may be performed on certain days and/or times. For example, 9 AM E.T., 5 PM E.T., 8 PM E.T., a certain day of the week, or a certain date of the month, to name a few. Certain sweep transactions may require user approval. Such transactions may be defined by transaction parameters or transaction characteristics, such as source account identifiers, destination account identifiers, transfer amounts, and/or allocation amounts, to name a few. Transaction satisfying certain predefined characteristics may require user approval, such as transactions to or from particular accounts or institutions or transactions involving amounts exceeding a preset permissible transfer amount. Such characteristics may be stored as exceptions to default permissible transaction characteristics.

A transaction management computer system may monitor one or more accounts at one or more source and/or depository institutions to obtain the information necessary to determine when sweep transaction triggers occur. Such information can include account balance information, pending order information, and/or transaction information, such as completed order information. Account monitoring may be performed according to a predefined schedule, e.g., once per day, such as at 5 PM E.T., twice per day, such as at 9 AM E.T. and 5 PM E.T., once per week, once per month, twice per month, to name a few. An account monitoring frequency may govern how often to monitor one or more accounts. The system may monitor accounts on demand, e.g., upon receipt of a user electronic request to refresh account information. In embodiments, the system may receive or may determine an account update schedule for one or more particular institutions, e.g., brokerage institutions. Such a schedule may identify when account information is updated for access via a computer-based portal or may identify when transactions involving the account are executed or settled. The system may monitor the accounts according to the schedule of updates.

Thus, the present invention improves upon prior computer implemented deposit sweep systems, which could not automatically institute such a trigger themselves and instead would need to rely upon source institutions or the customer to initiate a sweep event. Thus, the technological solution of the present invention is very advantageous. It can expand the scope of sweep programs to cover additional source and/or

depository institutions and/or can automate sweep triggering, such as deposit sweep triggering, without input or instruction from third parties other than sweep settings, which may be stored in advance in memory and may be optional.

In embodiments, the transaction management system may monitor a customer's emails, e.g., by accessing the customer's email account using email login credentials for the email account. The system may search for and/or determine emails matching certain criteria, such as one or more sender names or sender email addresses, e.g., corresponding to financial institutions, and/or determining subject or body information matching certain predefined text (e.g., the words "account", "balance", and/or "transaction", to name a few). In embodiments, the system may receive forwarded emails from the customer. The customer may set rules to forward transaction notification emails or other relevant emails automatically. In embodiments, the customer may specify, at the source and/or destination institutions, a transaction management system email address to receive account alerts. Upon receipt or detection of such an email, the transaction management system may retrieve account information from one or more source and/or depository institution accounts associated with the customer.

Referring to FIG. **5**A, a flow chart is shown comprising embodiments for processing account fund movement transactions. In embodiments, the operations S**502***a* and S**504***a* comprise monitoring a source account. Block S**502***a* comprises a computer-implemented operation of obtaining, e.g., retrieving or receiving, by the TMS **120** computer system, source account balance information from a source institution. In embodiments, this operation may comprise accessing the source institution server computer system **106** via the one or more communications networks **50** and accessing the client source account balance information using the client source account authentication data from electronic storage **314**. In embodiments, one or more application programming interfaces ("APIs") may be used to access data from the source institution computer systems. In some embodiments, a screen scraping process may be used, whereby the TMS **120** computer system may access a source institution account information website, obtain the corresponding website data (e.g., by accessing the website page source information), and/or parse the website data to determine the relevant source account balance information. In embodiments, scraping can comprise accessing webpage data, parsing the webpage data, searching webpage data (e.g., GUI data and/or underlying front end webpage code, such as HTML) for one or more data items (e.g., words and/or characters such as "account", "balance", "$"), and/or performing regular expression matching to find particular expressions. In embodiments, this obtaining-the-balance operation S**502***a* may be performed by periodic polling based at least in part upon electronically stored client polling instructions, and the source balance information stored in the client source account balance data storage **318**. In embodiments, this obtaining operation may be triggered by the receipt of pushed client transaction data indicating a buy order or a sell order or receipt of a notice that there has been a change to the source account balance. In embodiments, this balance-obtaining operation may comprise receiving a client source account balance that has been pushed from one of the client devices or from the source institution (based at least in part upon authority from the client) when there has been a change to the client source account balance. Note that for convenience of explanation, the source institution and source account has been referred to in the singular. However, in embodiments, there may be a plurality of source accounts and a plurality of source institutions.

Block S**504***a* comprises a computer-implemented operation of obtaining, e.g., retrieving or receiving, by the TMS **120** computer system source account transaction information from a source institution. In embodiments, this operation may comprise accessing the source institution server computer system **106**, e.g., a broker-dealer for example, via the one or more communications networks **50**, and polling for source account transaction information including data for one or more buy or sell orders using the client authentication data from storage **314**. In embodiments, one or more APIs may be used to access data from the source institution computer systems. In embodiments, a screen scraping process may be used to obtain this data. In embodiments, this obtaining-transaction data operation S**504***a* may be performed periodically based at least in part upon electronically stored client polling instructions using the source account transaction information stored in the client source account transaction storage **322**. In embodiments, this obtaining operation may be triggered by the receipt of pushed client transaction data indicating a buy order or a sell order or receipt of a notice that there has been a change to the source account balance.

Block S**506***a* comprises a computer-implemented operation of transforming data to determine, by the transaction management system **120**, when there is transaction data for one or more pending buy and/or sell orders with corresponding order amounts, whether a sufficient source account balance is available to cover the one or more orders. In embodiments, this operation may comprise transforming data, e.g., via a netting operation, and based at least in part on the buy and/or sell orders to determine a net of the orders. When the net is a net buy order, the TMS **120** may further transform data, e.g., using a subtraction operation, and based at least in part the amount of the net buy order and the amount of the source account balance, to determine if the source account balance is equal to or greater than the amount of the net buy order. When the answer is YES, the operation may return to block S**502***a*, e.g. for continued account balance monitoring and/or transaction monitoring. When the answer is NO, the TMS **120** may determine a deficiency amount and proceed to block S**508***a*. In embodiments, when the answer is NO, then the system may generate and send an electronic notification, by the one or more intermediary computers and the one or more networks to the client.

Block S**508***a* comprises a computer-implemented operation of obtaining, e.g., retrieving or receiving, by the TMS **120** computer system, destination account balance information from one or more destination institutions. In embodiments, this operation may comprise accessing the destination institution server computer system **130** via the one or more communications networks **50**, and accessing the client destination account balance information using the client destination account authentication data from electronic storage **316**. In embodiments, one or more APIs may be used to access data from the one or more destination institution computer systems. In embodiments, a screen scraping process may be used. In embodiments, this obtaining-the-balance operation S**508***a* may be performed by periodic polling based at least in part upon electronic client polling instructions, and the retrieved destination balance information stored in the client destination account balance data storage **320**. In embodiments, this obtaining operation may be triggered by the receipt of pushed client transaction data indicating a buy order or a sell order or receipt of a notice that there has been a change to the source account balance

or the destination account balance. In embodiments, this operation may comprise receiving a client destination account balance that has been pushed from one of the client devices or from the destination institution (based at least in part upon authority from the client) when there has been a change to the client destination account balance. In embodiments, this operation may only be triggered by a determination that the client source account balance is not sufficient to cover a net buy order. In embodiments, when the destination balance from one or from a set of the destination accounts is not sufficient to cover the deficiency amount, then the system may generate and send an electronic notification, by the one or more intermediary computers and the one or more networks to the client.

Note that in embodiments the obtaining/retrieving operations of blocks **S502***a*, **S504***a* and **S508***a* may be performed while bypassing the automatic fund transfer programs of clearing firm computers, and/or source institution computers and/or destination institution computers, and without regard to consent and/or the electronic cooperation of the source institution and/or destination institution systems. Likewise, in embodiments the generating and executing operations of blocks **S512***a* and **S514***a* may be performed while bypassing the automatic fund transfer programs of clearing firm computers, and/or source institution computers and/or destination institution computers and without regard to consent and/or the electronic cooperation of the source and destination institution systems. In embodiments, this bypassing may be accomplished via access using the client source and destination authentication information.

Thus, in embodiments, the computer-implemented operation may comprise directly accessing using client's credentials with the client's authority, by the one by the one or more intermediary computers via one or more networks, the desired information without requiring a computer of the client or the source institution computer and/or the destination institution computer to initiate the access.

In embodiments, the computer-implemented operation may comprise directly accessing using client's credentials with clients authority in response to a trigger notification of a transaction from the client computer, by the one by the one or more intermediary computers via one or more networks, the desired information without requiring the client computer or the source institution computer and/or the destination institution computer to initiate the access.

In embodiments, the computer-implemented operation may comprise periodically or aperiodically obtaining, by the one by the one or more intermediary computers via one or more networks, the desired information while bypassing one or more automatic fund transfer programs of the source institution computer and/or the destination institution computer and/or a clearing firm computer of a clearing firm, and without regards to consent of the source institution computer and/or the destination institution computer and/or the clearing firm computer.

In embodiments, the computer-implemented operation may comprise periodically or aperiodically directly accessing, by the one by the one or more intermediary computers via one or more networks, the desired information without regards to consent of the source institution computer and/or the destination institution computer and/or the clearing firm computer.

In embodiments, the computer-implemented operation may comprise periodically or aperiodically directly accessing, by the one by the one or more intermediary computers via one or more networks, the desired information while blocking operation of a sweep program by the source institution computer and/or the destination institution computer and/or a clearing firm computer of a clearing firm and without regards to consent of the source institution computer and/or the destination institution computer and/or the clearing firm computer.

In embodiments, the computer-implemented operation may comprise periodically or aperiodically directly accessing, by the one by the one or more intermediary computers via one or more networks, the desired information while maintaining an election or confirming operation of an election to not use a sweep program by the source institution computer and/or the destination institution computer and/or a clearing firm computer of a clearing firm and without regards to consent of the source institution computer and/or the destination institution computer and/or the clearing firm computer.

In embodiments, the computer-implemented operation may comprise determining if the source institution computer and/or the destination institution computer and/or a clearing firm computer of a clearing firm has an active sweep program, setting an election to deactivate use of the active sweep program when it has been determined that such sweep program is active; and periodically or aperiodically directly accessing, by the one by the one or more intermediary computers via one or more networks, the desired information for the account without regards to consent of the source institution computer and/or the destination institution computer and/or a clearing firm computer.

Block **S510***a* comprises a computer-implemented operation of the transaction management system **120** determining if the balance maintained in the one or more client destination accounts is sufficient to cover at least the deficiency amount. In embodiments, this computer operation may comprise subtracting the deficiency amount from the destination balance of a destination account. In embodiments, the operation may comprise determining whether a destination account balance or a combination of destination account balances is greater than or equal to the deficiency amount. A transaction rule may require the system to maintain minimum balances in the one or more destination accounts, which may cause the transaction management system to determine whether the deficiency amount is available from a single destination account or otherwise whether an aggregate amount equaling the deficiency amount is available from a plurality of destination accounts, without violating the minimum account balance rule.

Block **S512***a* comprises a computer-implemented operation of the transaction management system **120** generating electronic transaction instructions to transfer an amount of funds from one or more client destination accounts to cover the deficiency amount. In embodiments, appropriate client source account authentication data may be obtained from the storage **314** and/or appropriate client destination account authentication data may be obtained from the storage **316** and used to generate the electronic transaction instructions. In embodiments, this operation may comprise selecting one of the destination accounts from which to transfer funds, by the one or more intermediary computers, based at least in part upon one or more criteria. In embodiments the one or more criteria may comprise at least one selected from the group of a client preference, minimizing a number of transfers necessary to cover the deficiency amount, and selecting one of the destination accounts which has client funds in the account that exceed an FDIC insurance limit.

Block **S514***a* comprises a computer-implemented operation of the transaction management system **120** executing or having executed the electronic transaction instructions. In

embodiments, this operation may comprise initiating transfer of an amount from one or more of the client destination accounts to the source account using the destination account authentication credentials. In embodiments, this operation may comprise electronically transmitting the generated instructions via the one or more networks. Accordingly, executing the transaction instructions can comprise transmitting instructions to the one or more destination account institution computer systems to perform a fund transfer having a respective associated transfer amount and identifying the source account as the transfer recipient. In embodiment, when transaction data is obtained that represents a net buy order, the generating and sending or make accessible the one or more electronic instructions to transfer to the cover the deficiency amount is set to operate within a predetermined time period after a time associated with the source transaction data, so that the one or more buy orders are not defaulted.

Thus, in embodiments, the computer-implemented operation may comprise directly instructing the source institution computer or the destination institution computer to make a fund transfer using the client's credentials with the client's authority, by the one by the one or more intermediary computers via one or more networks, without requiring the client's computer or the source institution computer or the destination institution computer to initiate the request for transfer.

In embodiments, the computer-implemented operation may comprise directly instructing the source institution computer or the destination institution computer to make a fund transfer using client's the credentials with the client's authority in response to a trigger notification of a transaction from the client computer, by the one by the one or more intermediary computers via one or more networks, without requiring the client's computer or the source institution computer or the destination institution computer to initiate the request for transfer.

In embodiments, the computer-implemented operation may comprise periodically or aperiodically instructing the source institution computer or the destination institution computer to make a fund transfer, by the one by the one or more intermediary computers via one or more networks, while bypassing one or more automatic fund transfer programs of the source institution computer and/or the destination institution computer and/or a clearing firm computer of a clearing firm, and without requiring the client's computer or the source institution computer or the destination institution computer to initiate the request for transfer.

In embodiments, the computer-implemented operation may comprise periodically or aperiodically directly instructing the source institution computer or the destination institution computer to make a fund transfer, by the one by the one or more intermediary computers via one or more networks, without requiring the client's computer or the source institution computer or the destination institution computer to initiate the request for transfer.

In embodiments, the computer-implemented operation may comprise periodically or aperiodically directly instructing the source institution computer or the destination institution computer to make a fund transfer, by the one by the one or more intermediary computers via one or more networks, the desired information while blocking operation of a sweep program by the source institution computer and/or the destination institution computer and/or a clearing firm computer of a clearing firm and without requiring the client's computer or the source institution computer or the destination institution computer to initiate the request for transfer.

In embodiments, the computer-implemented operation may comprise periodically or aperiodically directly instructing the source institution computer or the destination institution computer to make a fund transfer, by the one by the one or more intermediary computers via one or more networks, the desired information while maintaining an election or confirming operation of an election to not use a sweep program by the source institution computer and/or the destination institution computer and/or a clearing firm computer of a clearing firm and without requiring the client's computer or the source institution computer or the destination institution computer to initiate the request for transfer.

In embodiments, the computer-implemented operation may comprise determining if the source institution computer and/or the destination institution computer and/or a clearing firm computer of a clearing firm has an active sweep program, setting an election to deactivate use of the active sweep program when it has been determined that such sweep program is active; and periodically or aperiodically directly instructing the source institution computer or the destination institution computer to make a fund transfer, by the one by the one or more intermediary computers via one or more networks, without requiring the client's computer or the source institution computer or the destination institution computer to initiate the request for transfer.

Block **S516***a* comprises a computer-implemented operation of the transaction management system **120** providing or making accessible over the one or more networks to the client device an electronic notification of the fund transfer from one or more of the client destination accounts to the source account. An electronic notification can comprise a push notification, an email, an SMS message, and/or an update to a TMS account activity log, to name a few. In embodiments, the client device may be a transaction history log maintained on a server of another, and may comprise updating that transaction history log. The client source account balance held in storage **318** and the respective one or more balances for the one or more destination accounts may then be updated. In embodiments, an electronic notification to proceed with a pending order may be transmitted to the source account.

Referring to FIG. **5**B, a further embodiment is disclosed. Block S**522***b* comprises a computer-implemented operation of the TMS **120** accessing, using one or more intermediary computers, one or more databases holding transaction rules and client authentication data. The client authentication data may be for a source institution to obtain source account balance information for the source account of the client held in the source institution and to obtain source transaction data for the source account. The client authentication data may also be for one or more destination institutions to obtain destination account balance data for one or more client destination accounts held in the one or more destination institutions. In embodiments, the one or more intermediary computers may not be affiliated with the source institution holding the source account or the one or more destination institutions holding the one or more destination accounts of the client.

Block **523***b* comprises a computer-implemented operation of the TMS **120** accessing account information for the source account using the client authentication data. Accessing account information can comprise logging into an account information portal (e.g., a website or an API, to name a few) or other portal provided by a source institution,

e.g., using the source account client authentication data. In embodiments, the transaction rules may govern the frequency with which source account information is accessed, monitored, and/or evaluated by the TMS **120** or the time of day or date when the account information is accessed.

Block S**524***b* comprises a computer-implemented operation of the TMS **120** periodically or aperiodically obtaining, by the one or more intermediary computers via one or more networks, the source account balance information for the source account. Note that for convenience of explanation, the source institution and source account have been referred to in the singular. However, in embodiments, there may be a plurality of source accounts and/or a plurality of source institutions.

In embodiments, the obtaining the source account balance information may comprise retrieving the source account balance information, via access to a server of the source institution, using the client source authentication data from the electronic storage **314**. In embodiments, source account balance information may be scraped from a website provided by the source institution server. In embodiments, scraping can comprise accessing webpage data, parsing the webpage data, searching webpage data (e.g., GUI data and/or underlying front end webpage code, such as HTML) for one or more data items (e.g., words and/or characters such as "account", "balance", "$"), and/or performing regular expression matching to find particular expressions. In embodiments, the operation of obtaining source account balance information may be based at least in part upon automatic polling (e.g., a scheduled data retrieval process) or may be triggered by receiving data that a change has occurred in the source account balance and/or that a transaction order or a net buy order has been received.

In embodiments, the obtaining the source transaction data, and/or the source account balance information, may comprise receiving automatically pushed data (e.g., one or more data packets and/or electronic files) via the one or more data networks.

Block S**526***b* comprises a computer-implemented operation of the TMS **120** periodically or aperiodically obtaining, by the one or more intermediary computers via the one or more networks, the destination account balance information for the one or more destination accounts.

In embodiments, the obtaining the destination account balance information may comprise retrieving the destination account balance information, via access to a server of the destination institution, using the client destination account authentication data from the electronic storage **316**. In embodiments, destination account balance information may be scraped from a website provided by the destination institution server. In embodiments, this operation may be based at least in part upon automatic polling (e.g., according to a balance retrieval schedule, such as each business day at 5 pm) or may be triggered by receiving data indicating that a change has occurred in the destination account balance or that a transaction order or a net buy order has been received.

In embodiments, the obtaining the destination account balance information may comprise receiving an automatically pushed file and/or data packets via the one or more networks.

Block S**528***b* comprises a computer-implemented operation of the TMS **120** periodically or aperiodically obtaining the source transaction data comprising one or more buy orders and/or sell orders for the source account, by the one or more intermediary computers via the one or more networks. In embodiments, the obtaining the source transaction data may comprise retrieving the source transaction data, via access to a server of the source institution, using the client source authentication data from the electronic storage **314**. In embodiments, source transaction data may be scraped from a website provided by the source institution server, such as a transaction webpage identifying one or more pending transactions. In embodiments, this operation may be based at least in part upon automatic polling or may be triggered by receiving data that a change has occurred in the source account balance or that a transaction order or a net buy order has been received and/or placed.

In embodiments, the obtaining the source transaction data, may comprise receiving an automatically pushed file and/or data packets via the one or more networks.

Block S**528***b* comprises a computer-implemented operation of the TMS **120** transforming data, e.g., using a netting operation, and using at least in part information in the transaction data, to determine, by the one or more intermediary computers, that the source transaction data for the source account represents a net buy order with a net buy amount. In embodiments, this operation may comprise first determining a net of any buy and sell amounts and then determining whether the net is a net buy amount. In embodiments, the operation may comprise determining that a given order is a buy order with a buy amount.

Block S**530***b* comprises a computer-implemented operation of obtaining, e.g., retrieving or receiving, by the TMS **120** computers, destination account balance information from one or more destination institutions. In embodiments, this operation may comprise accessing the destination institution server computers **130** via the one or more communications networks **50**, and accessing the client destination account balance information using the client destination account authentication data from electronic storage **316**. In embodiments, one or more application programming interfaces ("API") may be used to access data from the one or more destination institution computer systems. In embodiments, a screen scraping process may be used. In embodiments, this obtaining-the-balance operation S**530***b* may be performed by periodic polling based at least in part upon client polling instructions. In embodiments, this obtaining operation may be triggered by the receipt of pushed client transaction data indicating a buy order or a sell order or a net buy order or a determination of a net buy order or receipt of a notice (e.g., an electronic indication) that there has been a change to the source account balance or the destination account balance. In embodiments, this operation may comprise receiving a client destination account balance that has been pushed from one of the client devices or from the destination institution (based at least in part upon authority from the client) when there has been a change to the client destination account balance. In embodiments, this operation may only be triggered by a determination that the client source account balance is not sufficient to cover a net buy order. Accordingly, in embodiments, this operation may be performed following step S**532***b*. The obtained destination balance information may be stored in the client destination account balance data storage **320**.

Note that the obtaining/retrieving operations of blocks S**524***b*, S**526***b* and S**530***b* may be performed while bypassing the automatic fund transfer programs of clearing firm computers, and/or source institution computers, if any, with the different permutations described above, and without regards to consent of the source and destination institutions or the electronic cooperation of the source and destination computers. In embodiments, this bypassing may be accomplished via the client source and destination authentication information.

Block S532*b* comprises a computer-implemented operation of transforming data to determine, by the transaction management system **120**, when there is transaction data for one or more pending buy and/or sell orders with respective order amounts, whether a sufficient source account balance is available to cover the one or more orders. In embodiments, this operation may comprise transforming data, e.g., using a subtraction operation, and based at least in part the amount of the net buy order and the amount of the source account balance, to determine if the source account balance is equal to or greater than the net buy amount of the net buy order. When the answer is YES, then returning the operation to block S524*b* for further monitoring of account balances and/or transaction orders. When the answer is NO, then proceeding to block S534*b*.

Block S534*b* comprises a computer-implemented operation of the TMS **120** determining a deficiency amount, by the one or more intermediary computers, when a source account balance for the source account does not equal or exceed the net buy amount for the net buy order, based at least in part on the source account balance information for the source account. In embodiments, the determination may also be based at least in part upon the net buy amount (and/or the constituent amounts corresponding to the constituent orders thereof). In embodiments, this operation may comprise subtracting the net buy amount from the source account balance to determine the deficiency amount, or vice versa, and/or computing the absolute value of the difference as needed.

Block S536*b* comprises a computer-implemented operation of the TMS **120** generating, by the one or more intermediary computers, electronic transaction instructions for a transfer from at least one of the one or more destination accounts to the source account of at least the deficiency amount, including the respective client authentication data for the one or more destination accounts and the one or more source accounts. In embodiments, this operation may comprise accessing the appropriate client source account authentication data from the storage **314** and/or accessing the appropriate client destination account authentication data from the storage **316** for the instruction. In embodiments, only the client destination account authentication data may be needed. In embodiments, the electronic transaction instructions may comprise sending account identifiers (e.g., identifying the one or more client destination accounts from which to transfer funds), corresponding destination account authentication data, a transaction recipient account identifier (e.g., identifying the source account to which to transfer funds), and respective transfer amounts for each sending account. In embodiments, the instructions may be to transfer only the deficiency amount. In embodiments, the instructions may be to transfer the deficiency amount plus an additional amount (e.g., a fixed additional amount or a percentage additional amount). In embodiments, the additional amount may be based at least in part on a minimum source account balance rule set for the source account by the TMS rules module **324**.

Block S538*b* comprises a computer-implemented operation of the TMS **120** executing or having executed, by the one or more intermediary computers and the one or more networks, the electronic transaction instructions. In embodiments, this operation may comprise executing or having executed the transaction instructions on the servers for the one or more destination institutions corresponding to the sending accounts, which execution may comprise selecting a transfer funds option (e.g., activating a button, indicator, or other user interface element) on the user interface provided by a destination institution computer system and/or inputting required transaction parameter information, such as a transfer amount and a transfer recipient (e.g., the source account identifier). Having instructions executed may thus comprise initiating a transaction at a destination institution computer system.

Block S540*b* comprises a computer-implemented operation of the TMS **120** computer system generating and/or sending an electronic notification, by the one or more intermediary computers and the one or more networks, of the transfer. In embodiments, the electronic notification may be transmitted to a user device associated with the TMS account owner. In embodiments, the electronic notification may comprise an update to a TMS transaction log provided via a TMS website and/or software application (e.g., a TMS mobile application running on one or more processors of a user device). In embodiments, the electronic notification may comprise an email, SMS message, and/or other electronic communication. In embodiments of the present invention, electronic notifications may provide an alert that account information has been updated and/or that a user response is requested, which alert may prompt or request the user to log into a secure GUI, e.g., via a web browser or dedicated application, to view the notification.

Referring to FIG. **5**C, a yet further embodiment of the invention is disclosed. This figure is the same as FIG. **5**B except that operations S524*c*, S526*c*, and S530*c* comprise receiving operations to reflect that one or more or all of these operations may receive data that has been pushed to the TMS **120** from the client device and/or the source institution and/or the one or more destination institutions.

Referring to FIG. **5**D, a yet further embodiment of the invention is disclosed. This figure is the same as FIG. **5**B except that operations S524*d*, S526*d*, and S530*d* are retrieving steps performed by the TMS **120** instead of "obtaining" steps, to reflect that one or more or all of these operations may retrieve data by accessing the client device and/or the computer servers of the source institution and/or the computer servers of the one or more destination institutions using the respective client authentication information. In embodiments, as noted the retrieving operations (e.g., steps S524*d*, S526*d*, S530*d*) may comprise using one or more application programming interfaces (APIs) to access data from these third-party computer systems. In embodiments, data may be retrieved by scraping data from websites associated with the third-party computer systems, as discussed herein. In embodiments, any combination of receiving and retrieving operations may be used by the TMS to perform these steps.

FIGS. **5**E-**1**-**5**E-**3** show an exemplary process for performing a bypass cash sweep and in particular a deposit sweep to fund a source account, e.g., a trading account, in accordance with embodiments of the present invention. The source account may be funded, at least in part, from a depository account, which may be an interest-bearing account and/or a highly liquid account, such as a bank account, money fund account, exchange-traded fund (ETF) account, to name a few. In embodiments, the depository account may be considered a destination account, even where funds are being transferred from the destination account to the source account.

In a step S552, one or more transaction management computers may generate first machine-readable instructions to render an account access information graphical user interface comprising account credential input fields. In embodiments, the machine-readable instructions may comprise any of data, graphical elements, layout and/or style

code (e.g., Cascading Style Sheets (CSS)), content code (e.g., expressed in a mark-up language, such as HTML), and/or code for processing user inputs (e.g., expressed in JavaScript, PHP, Objective-C, and/or Java, to name a few).

In a step **S554**, the one or more transaction management computers may transmit to a client device the first machine-readable instructions, causing an interface application at the client device to be activated to render the account access information graphical user interface on a display screen operatively connected to the client device. In embodiments, the client device may be any of a personal computer, laptop computer, tablet computer, cell phone, smart phone, mobile devices, personal digital assistant, and/or wearable electronic device, to name a few.

In a step **S556**, the one or more transaction management computers may receive from the client device via the account access information graphical user interface, source account access information for a source account of a client associated with the client device, the source account held at a source institution and the source account access information comprising source account identifying information and source account authentication information.

In a step **S558**, the one or more transaction management computers may store the source account access information in one or more databases comprising non-transitory computer-readable memory. In embodiments, each time account access information for source or depository accounts is received, such information may be stored in the one or more databases.

In a step **S559**, the one or more transaction management computers may obtain from the one or more databases the source account access information. Where such information was just received at the one or more transaction management computers, it may already be in working memory and may not need to be retrieved from the one or more databases. In embodiments, account access information may be obtained from the one or more databases without receiving such information anew from the client device each time.

In a step **S560**, the one or more transaction management computers may obtain one or more transaction rules.

In a step **S562**, the one or more transaction management computers may obtain source account transaction data comprising one or more buy orders and/or sell orders for the source account by. The source account transaction data may be obtained according to the one or more transaction rules, which may specify a frequency, e.g., an account monitoring frequency, for obtaining (e.g., retrieving) source account transaction data. In embodiments, the one or more transaction management computers may obtain the source account transaction data by accessing, using the source account access information, a source account information portal of a source institution computer system associated with the source institution, wherein access to the source account information portal does not require specialized technological access to the source institution computer system or authorization from the source institution beyond the technological access and authorization provided to the client. The one or more transaction management computers may then obtain the source account transaction data via the source account information portal.

In embodiments, the source account information portal may comprise a text-based interface, such as a command line interface. In other embodiments, the source account information portal may comprise a graphical user interface. In embodiments, the source account information portal may comprise a website accessible at a URL via the Internet. Obtaining the source account transaction data may comprise screen scraping. In other embodiments, the source account information portal may comprise an application programming interface (API), which may be used by one or more other computer systems and/or user devices to request information from the source institution computer system and/or submit information to the source institution computer system.

In a step **S564**, the one or more transaction management computers may determine that the source transaction data represents a net buy order having a net buy amount based at least in part on information in the transaction data.

In a step **S566**, the one or more transaction management computers may obtain, via the source account information portal, source account balance information for the source account comprising a source account balance.

In a step **S568**, the one or more transaction management computers may determine that the source account balance does not equal or exceed the net buy amount for the net buy order. In embodiments, the transaction rules may comprise a source account minimum balance amount. The one or more transaction management computers may determine that the source account balance does not exceed the net buy amount by at least the source account minimum balance amount, e.g., so as to ensure that the source account minimum balance is maintained.

In a step **S570**, the one or more transaction management computers may determine a deficiency amount based at least in part on the source account balance information and the net buy amount.

In a step **S572**, the one or more transaction management computers may access the one or more databases to obtain depository account access information for a depository account held at a depository institution, the depository account access information comprising at least depository account identifying information and depository account authentication information.

In a step **S574**, the one or more transaction management computers may obtain depository account balance information for the depository account comprising a depository account balance by accessing, using the depository account access information, a depository account information portal of a depository institution computer system associated with the depository institution, wherein access to the depository account information portal does not require specialized technological access to the depository institution computer system or authorization from the depository institution beyond the technological access and authorization provided to the client. The one or more transaction management computers may then obtain, via the depository account information portal, the depository account balance information.

In a step **S575**, the one or more transaction management computers may determine that the depository account balance equals the deficiency amount or exceeds the deficiency amount by at least a depository account balance threshold amount. In embodiments, the depository account balance threshold amount may be a depository account minimum balance, which may be specified by the client or by the depository institution. It may be a minimum balance required to avoid incurring fees. In embodiments, the depository account balance threshold amount may be zero, meaning there is no minimum balance that must be maintained for the depository account.

In embodiments, the one or more transaction management computers may generate a second electronic notification, which may comprise an indication of a proposed sweep transfer of at least the deficiency amount from the depository

account to the source account. In embodiments, the second electronic notification may comprise a request for authorization to proceed with the proposed sweep transfer. The second electronic notification may indicate the amount proposed to be transferred. In embodiments, the second electronic notification may only indicate that a transfer of funds is proposed. The one or more transaction management computers may transmit the second electronic notification to the client device and/or to another user device associated with the client. In embodiments, the one or more transaction management computers may receive, e.g., from the client device, an electronic authorization to proceed with the proposed sweep transfer. In embodiments, the electronic authorization may be encrypted using an asymmetric private key generated based at least in part upon an invariant biometric feature vector, which may be associated with the client. In embodiments, other encryption algorithms may be used.

In a step S**576**, the one or more transaction management computers may generate electronic transaction instructions for a transfer of at least the deficiency amount from the depository account to the source account. In embodiments, the electronic transaction instructions may comprise ACH instructions. In embodiments, the electronic transaction instructions may comprise commands input via a depository account transaction portal of the depository institution computer system. In embodiments, the depository account transaction portal may comprise a transaction graphical user interface with a recipient address input element and a transaction amount input element. In embodiments, the depository account transaction portal may comprise an API for accessing the depository institution computer system. The API can include account authentication verification commands to identify the depository account and/or verify the credentials associated with a request for transactions (e.g., fund transfers) from a particular depository account.

In a step S**578**, one or more transaction management computers may provide to the depository institution computer system via a depository account transaction portal of the depository institution computer system, the electronic transaction instructions causing the depository institution computer system to execute the transfer.

In a step S**580**, one or more transaction management computers may generate an electronic notification of the transfer. The electronic notification may indicate that a transfer occurred, the amount transferred, the date and/or time of the transfer, and/or the one or more sending account and/or recipient account, to name a few. In embodiments, the electronic notification may comprise an updated source account balance after the transfer is executed or an updated depository account balance after the transfer is executed.

In a step S**582**, one or more transaction management computers may transmit to the client device the electronic notification of the transfer.

In embodiments, the one or more transaction management computers may determine that the deficiency amount exceeds the depository account balance. The one or more transaction management computers may then generate a second electronic notification comprising an indication of the deficiency amount and transmit the second electronic notification to the client device. In embodiments, the second electronic notification may comprise account input fields to identify a second depository account and/or associated second depository account access credentials.

In embodiments, the one or more transaction management computers may obtain depository account balance information for a plurality of depository accounts. The one or more transaction management computers may generate electronic transaction instructions for transfers of a portion of at least the deficiency amount from each of a plurality of the depository accounts to the source account. The one or more transaction management computers may then provide the electronic transaction instructions to respective depository institution computer systems via respective depository account transaction portals, causing the depository institution computer systems to execute the transfers. The one or more transaction management computers may determine the depository accounts from which to transfer funds based at least in part upon the transaction rules. The transaction rules may comprise any of minimizing a number of transfers necessary to cover the deficiency amount, preferencing depository accounts that have no FDIC coverage, using depository accounts according to a preference order specified by the client and/or specified by a deposit sweep program administrator, and/or preferencing depository accounts based at least in part upon their respective balances and/or numbers of accounts (e.g., whether an account holds multiple small accounts or a few large accounts, to name a few).

In embodiments, a system for performing cash sweep transactions, e.g., deposit sweep transactions, that bypass source and/or destination institution technological cooperation can comprise one or more processors and non-transitory computer-readable memory having stored thereon instructions to perform the steps of obtaining, by one or more transaction management computers from one or more databases comprising non-transitory computer-readable memory, source account access information for a source account of a client, the source account held at a source institution and the source account access information comprising source account identifying information and source account authentication information; obtaining, by the one or more transaction management computers, one or more transaction rules; obtaining, by the one or more transaction management computers according to the one or more transaction rules, source account transaction data comprising one or more buy orders and/or sell orders for the source account by accessing, by the one or more transaction management computers using the source account access information, a source account information portal of a source institution computer system associated with the source institution, wherein access to the source account information portal does not require specialized technological access to the source institution computer system or authorization from the source institution beyond the technological access and authorization provided to the client, and by obtaining, via the source account information portal, the source account transaction data; determining, by the one or more transaction management computers, that the source transaction data represents a net buy order having a net buy amount based at least in part on information in the transaction data; obtaining, by the one or more transaction management computers via the source account information portal, source account balance information for the source account comprising a source account balance; determining, by the one or more transaction management computers, that the source account balance does not equal or exceed the net buy amount for the net buy order; determining, by the one or more transaction management computers, a deficiency amount based at least in part on the source account balance information and the net buy amount; accessing, by the one or more transaction management computers, the one or more databases to obtain depository account access information for a depository account held at a depository institution, the depository account access infor-

mation comprising at least depository account identifying information and depository account authentication information; obtaining, by the one or more transaction management computers, depository account balance information for the depository account comprising a depository account balance by accessing, by the one or more transaction management computers using the depository account access information, a depository account information portal of a depository institution computer system associated with the depository institution, wherein access to the depository account information portal does not require specialized technological access to the depository institution computer system or authorization from the depository institution beyond the technological access and authorization provided to the client, and by obtaining, via the depository account information portal, the depository account balance information; determining, by the one or more transaction management computers, that the depository account balance equals the deficiency amount or exceeds the deficiency amount by at least a depository account balance threshold amount; generating, by the one or more transaction management computers, electronic transaction instructions for a transfer of at least the deficiency amount from the depository account to the source account; providing, by the one or more transaction management computers to the depository institution computer system via a depository account transaction portal of the depository institution computer system, the electronic transaction instructions causing the depository institution computer system to execute the transfer; generating, by the one or more transaction management computers, an electronic notification of the transfer; and transmitting, by the one or more transaction management computers to a client device associated with the client, the electronic notification of the transfer.

In embodiments, a method for performing brokerage transactions associated with a cash sweep program such as a deposit sweep program and authorizing sweep transfers, from a client device perspective, can comprise transmitting, from a client device associated with a client to a transaction management computer system comprising one or more computers, client access credentials associated with a transaction management account. The client access credentials may have been input via a user input device embedded in and/or operatively connected to the client device. The credentials may thus have been populated into respective client access credential input fields on a login GUI displayed on a display screen embedded in and/or operatively connected to the client device.

The client device may receive from the transaction management computer system machine-readable instructions to render an account information graphical user interface. The client device may then receive from a user input device (e.g., keyboard, keypad, touch pad, touch screen, mouse, microphone, camera, scanner, etc.) source account access information for a source account of the client, the source account held at a source institution and the source account access information comprising source account identifying information and source account authentication information. The client device may transmit to the transaction management computer system, via the account information graphical user interface, the source account access information.

In embodiments, the client device may also receive, e.g., from the user input device, depository account access information for a depository account of the client, the depository account held at a depository institution and the depository account access information comprising depository account identifying information and depository account authentication information. The client device may transmit the depository account access information to the transaction management computer system, e.g., via the account information graphical user interface.

The client device may access a source account transaction portal of a source institution computer system associated with the source institution. The source account transaction portal, which may comprise a graphical user interface or an API, may comprise transaction parameter options for transactions from the source account. Transaction parameter options can include order amounts (e.g., buy amounts, sell amounts, limit amounts, transaction time parameters (e.g., to execute the transaction at a specify date and/or time), and/or security identifiers (e.g., stock symbols) associated with the order, to name a few). The client device may transmit to the source institution computer system via the source account transaction portal electronic transaction instructions comprising transaction parameters (e.g., parameters input and/or selected by the client).

The client device may then receive from the transaction management computer system a first electronic notification of a proposed sweep transfer from a deposit account associated with the client to the source account, the transaction management computer system having monitored the source account using the source account authentication information to access a source account information portal of the source institution computer system and having determined a deficiency of funds in the source account based at least in part upon pending order information obtained via the source account information portal.

The client device may transmit to the transaction management computer system an electronic authorization to perform the proposed sweep transfer. In embodiments, the electronic authorization may comprise an encrypted message, which may be encrypted using a biometric-derived private key. The client device may thereafter receive from the transaction management computer system a second electronic notification comprising an indication that the proposed sweep transfer was executed.

In embodiments, a system for performing cash sweep transaction such as deposit sweep transactions that bypass source and/or destination institution technological cooperation can comprise one or more processors and non-transitory computer-readable memory having stored thereon instructions to perform the steps of transmitting, from a client device associated with a client to a transaction management computer system comprising one or more computers, client access credentials associated with a transaction management account; receiving, at the client device from the transaction management computer system, machine-readable instructions to render an account information graphical user interface; receiving, at the client device from a user input device, source account access information for a source account of the client, the source account held at a source institution and the source account access information comprising source account identifying information and source account authentication information; transmitting, from the client device to the transaction management computer system via the account information graphical user interface, the source account access information; accessing, by the client device, a source account transaction portal of a source institution computer system associated with the source institution, the source account transaction portal comprising transaction parameter options for transactions from the source account; transmitting, by the client device to the source institution computer system via the source account transaction portal, electronic transaction instructions comprising transaction

parameters; receiving, at the client device from the transaction management computer system, a first electronic notification of a proposed sweep transfer from a deposit account associated with the client to the source account, the transaction management computer system having monitored the source account using the source account authentication information to access a source account information portal of the source institution computer system and having determined a deficiency of funds in the source account based at least in part upon pending order information obtained via the source account information portal; transmitting, from the client device to the transaction management computer system, an electronic authorization to perform the proposed sweep transfer; and receiving, at the client device from the transaction management computer system, a second electronic notification comprising an indication that the proposed sweep transfer was executed.

Referring to FIG. **6**A, there are disclosed embodiments for monitoring and transferring excess funds from a source account to a destination account (e.g., an interest bearing account). The process may be performed by the TMS **120**, which may comprise a computer system having one or more computers, which may be intermediary computers with respect to a source institution computer system, destination institution computer systems, and/or user devices.

Block S**600***a* comprises a computer-implemented operation of the TMS **120** computer system accessing the one or more databases holding the transaction rules and the client authentication data for the source institution. In embodiments, the TMS **120** may also access client authentication data for the one or more destination institutions.

Block S**601***a* comprises a computer-implemented operation of accessing, by the TMS **120**, account information for a source account at the source institution using the client authentication data. Accessing account information may comprise logging into an account access portal (e.g., a website or API), such as by inputting the client authentication data (e.g., a username and password or additional authentication information). In embodiments, one or more transaction rules may govern the frequency with which the account information is accessed or the time of day or date when the account information is accessed, to name a few.

Block S**602***a* comprises a computer-implemented operation of obtaining, by the TMS **120**, from the source institution client source balance information, as described previously.

Block S**604***a* comprises a computer-implemented operation of the TMS **120** periodically or aperiodically obtaining the source transaction data comprising one or more buy orders and/or sell orders for the source account, by the one or more intermediary computers via the one or more networks. A purpose of this obtaining operation may be to determine if there are any pending buy or sell orders and/or completed transactions which may change the source account balance and affect whether there is an excess of funds in the source account. In embodiments, the obtaining the source transaction data may comprise retrieving the source transaction data, via access to a server of the source institution, using the client source authentication data from the electronic storage **314**. In embodiments, this operation may be based at least in part upon automatic polling or may be triggered by receiving data indicating that a change has occurred in the source account balance or that a transaction order or a net buy order or a net sell order has been received and/or that a transaction has been performed. In embodiments, this operation may be optional, as the source account balance may be queried to determine whether a balance change occurred (e.g., by comparing a current balance to a data record corresponding to a previous and/or last obtained balance).

Block S**606***a* comprises a computer-implemented operation by the TMS **120** computer system of transforming data to determine whether an excess source account balance exists. In embodiments, this operation may comprise comparing the client source account balance to a source account maximum balance amount recorded in the one or more databases and determining an excess amount, if any. In embodiments, such a determination may be determined via a subtraction operation of the source account maximum balance amount from the source account balance or via a comparison operation, such as an inequality test to determine whether a source account balance is greater than a predefined threshold. In embodiments, following a determination that a predefined threshold is exceeded, the TMS **120** may determine the excess amount.

Block S**608***a* comprises a computer-implemented operation by the TMS **120** computer system of generating electronic transaction instructions to transfer the excess amount of funds from the client source account to one or more of the client destination accounts. In embodiments, appropriate client source account authentication data, e.g., username and password, may be obtained from the storage **314**. In embodiments, appropriate client destination account authentication data, e.g., username and password, may also be obtained from the storage **316** to facilitate this transfer. In embodiments, source and/or destination account identifiers may be obtained. One or more destination account identifiers may identify the accounts to which the excess amount will be transferred. In embodiments, the electronic transaction instructions may comprise respective amounts to be transferred to each of the one or more destination accounts.

Block S**610***a* comprises a computer-implemented operation of the transaction management system **120** executing or having executed the transaction instructions. In embodiments, this operation may comprise initiating transfer of an amount from the respective source account to one or more of the client destination accounts using the destination account authentication credentials, as described. In embodiments, this operation may comprise selecting an execution or transfer button on an interface associated with the source institution computer system.

Block S**612***a* comprises a computer-implemented operation of the transaction management system **120** providing or making accessible over the one or more networks to the client device an electronic notification of the fund transfer from the source account to one or more of the client destination accounts. The client source account balance held in electronic storage **318** and the one or more client destination account balances held in the electronic storage **320** may then be updated. In embodiments, the client device may be a transaction history log maintained on a server of another, and may comprise updating the transaction history log. The transaction history log may be accessible via a website associates with the TMS **120** and/or via software, such as a mobile application running on a client device, such as a smart phone.

Referring to FIG. **6**B, a yet further embodiment of the invention is disclosed. This figure is the same as FIG. **6**A except that operations S**602***b* and S**604***b* comprise receiving operations to reflect that one or more of these operations may receive data that has been pushed and/or transmitted to the TMS **120** from the client device and/or the source institution.

Referring to FIG. **6**C, a yet further embodiment of the invention is disclosed. This figure is the same as FIG. **6**A except that the operations **S602***c* and **S604***c* are retrieving steps instead of obtaining steps, to reflect that one or more of these operations may retrieve data by accessing the client device and/or the computer servers of the source institution using the client authentication information, e.g., logging into the source account using the client source account credentials and/or using an API for accessing this information in the source account computer system.

In embodiments, any combination of receiving and retrieving operations may be used by the TMS **120** to perform these steps.

FIGS. **6**D-**1**-**6**D-**2** show an exemplary process for performing a bypass deposit sweep to maintain a source account maximum balance in accordance with embodiments of the present invention. In embodiments, variations of this exemplary process may be performed for other types of cash sweeps. A source account may be trading account, from which it is desirable to transfer excess funds to interest-bearing and/or insured accounts, such as depository accounts.

In a step **S622**, one or more transaction management computers may generate first machine-readable instructions to render an account access information graphical user interface comprising account credential input fields. Accordingly, the first machine-readable instructions may comprise display data, graphical elements, and/or computer code (e.g., style code, layout code, content expressed in a markup language, and/or input handling code), to name a few.

In a step **S624**, the one or more transaction management computers may transmit to a client device the first machine-readable instructions, causing an interface application at the client device to be activated to render the account access information graphical user interface on a display screen operatively connected to the client device.

In a step **S626**, the one or more transaction management computers may receive from the client device via the account access information graphical user interface (e.g., after input via a user input device), source account access information for a source account of a client associated with the client device, the source account held at a source institution and the source account access information comprising source account identifying information and source account authentication information.

In a step **S628**, the one or more transaction management computers may store the source account access information in one or more databases comprising non-transitory computer-readable memory.

In a step **S629**, the one or more transaction management computers may obtain the source account access information from the one or more databases. In embodiments where source account access information was previously stored in the one or more databases, the databases may be accessed and the source account access information retrieved without receiving such information anew from the client device.

In a step **S630**, the one or more transaction management computers may obtain one or more transaction rules comprising at least a source account maximum balance. In embodiments, the transaction rules may be obtained from one or more databases, which may have been populated based at least in part upon user-input transaction rules and/or transaction parameters. The transaction rules may further comprise an account monitoring frequency for obtaining source account balance data.

In a step **S632**, the one or more transaction management computers may obtain source account balance information for the source account, wherein the source account balance information comprises a source account balance. The one or more transaction management computers may access a source account information portal of a source institution computer system associated with the source institution using the source account access information. Access to the source account information portal may not require specialized technological access to the source institution computer system or authorization from the source institution beyond the technological access and authorization provided to the client. In embodiments, the source account information portal may comprise a graphical user interface. In embodiments, the portal may comprise a non-graphical interface, such as a text-based or command line interface. In embodiments, the source account information portal may comprise a GUI provided by an application, such as a mobile application running on a smart phone. In embodiments, the source account information portal may comprise a website accessible via the Internet at a URL. The one or more transaction management computers may then obtain the source account balance information via the source account information portal, e.g., by screen scraping. In embodiments, the source account information portal may comprise an API, accessible by one or more other computer systems and/or user devices.

In a step **S634**, the one or more transaction management computers may determine that the source account balance exceeds the source account maximum balance.

In a step **S636**, the one or more transaction management computers may determine an excess amount based at least in part upon the source account balance and the source account maximum balance.

In a step **S638**, the one or more transaction management computers may access the one or more databases to obtain depository account information for a depository account held at a depository institution, the depository account information comprising at least a depository account address.

In a step **S640**, the one or more transaction management computers may generate electronic transaction instructions for a transfer of at least the excess amount from the source account to the depository account. In embodiments, the electronic transaction instructions may comprise ACH instructions.

In a step **S642**, the one or more transaction management computers may provide to the source institution computer system the electronic transaction instructions causing the source institution computer system to execute the transfer. In embodiments, the electronic transaction instructions may be provided via a source account transaction portal of the source institution computer system. Such a source account transaction portal may comprise an API. In embodiments, the electronic transactions instructions may otherwise be transmitted to the source institution computer system.

In a step **S644**, the one or more transaction management computers may generate an electronic notification of the transfer.

In a step **S642**, the one or more transaction management computers may transmit to the client device the electronic notification of the transfer. The electronic notification may comprise a push notification that is automatically rendered on the client device. In embodiments, the electronic notification may comprise an email, SMS, or other electronic message. The electronic notification may be viewable in an interface application, such as a deposit sweep application running on the client device or an Internet browser application.

FIG. **6**E is a flow chart of an exemplary process for analyzing a depository account balance in accordance with exemplary embodiments of the present invention.

In a step S**652**, the one or more transaction management computers may obtain depository account access information comprising at least depository account authentication information.

In a step S**654**, the one or more transaction management computers may obtain depository account balance information for the depository account comprising a depository account balance. The one or more transaction management computers may access, using the depository account access information, a depository account information portal of a depository institution computer system associated with the depository institution. In embodiments, access to the depository account information portal may not require specialized technological access to the depository institution computer system or authorization from the depository institution beyond the technological access and authorization provided to the client. The one or more transaction management computers may then obtain the depository account balance information via the depository account information portal. In embodiments, the depository account information portal may comprise an API. In embodiments, the depository account information portal may comprise a website or dedicated application (e.g., mobile app) comprising one or more GUIs. In embodiments, obtaining data from the depository account information portal may comprise screen scraping.

In a step S**656**, the one or more transaction management computers may obtain depository account maximum balance information comprising a depository account maximum balance. The depository account maximum balance may be obtained from one or more databases. In embodiments, such databases may comprise user settings or preferences. In other embodiments, a deposit sweep program administrator or a depository institution may set the depository account maximum balance. In embodiments, the depository account maximum balance may be based at least in part upon a maximum insurable amount, e.g., for FDIC insurance. In embodiments, the depository account maximum balance may be coded as part of a logical rule for evaluating permissible depository account balances.

In a step S**658**, the one or more transaction management computers may determine that a post-transfer depository account balance will not exceed the depository account maximum balance. Such determination may comprise computing the post-transfer balance based at least in part upon the current balance and the excess amount to be transferred into the account, and comparing the computed post-transfer balance to the depository account maximum balance.

In embodiments, the one or more transaction management computers may determine a plurality of depository accounts into which to transfer portions of the excess amount. The plurality of depository accounts and the respective amounts to transfer to each may be determined so as not to exceed respective depository account balances. In embodiments, the determination of one or more depository accounts may be based at least in part upon any of interest rates (e.g., to give preference to higher interest-bearing accounts), current account balances, excess amount, maximum insurable limits for each respective account, number of sweep program clients (e.g., deposit sweep program clients) whose funds are in the account and/or sizes (e.g., balances) of such accounts, to name a few.

In embodiments, a system for performing deposit sweep transactions that bypass source and/or destination institution technological cooperation can comprise one or more processors and non-transitory computer-readable memory having stored thereon instructions to perform the steps of obtaining, by one or more transaction management computers from one or more databases comprising non-transitory computer-readable memory, source account access information for a source account of a client, the source account held at a source institution and the source account access information comprising source account identifying information and source account authentication information; obtaining, by the one or more transaction management computers, one or more transaction rules comprising at least a source account maximum balance; obtaining, by the one or more transaction management computers, source account balance information for the source account comprising a source account balance by accessing, by the one or more transaction management computers using the source account access information, a source account information portal of a source institution computer system associated with the source institution, wherein access to the source account information portal does not require specialized technological access to the source institution computer system or authorization from the source institution beyond the technological access and authorization provided to the client, and by obtaining, via the source account information portal, the source account balance information; determining, by the one or more transaction management computers, that the source account balance exceeds the source account maximum balance; determining, by the one or more transaction management computers, an excess amount based at least in part upon the source account balance and the source account maximum balance; accessing, by the one or more transaction management computers, the one or more databases to obtain depository account information for a depository account held at a depository institution, the depository account information comprising at least a depository account address; generating, by the one or more transaction management computers, electronic transaction instructions for a transfer of at least the excess amount from the source account to the depository account; providing, by the one or more transaction management computers to the source institution computer system via a source account transaction portal of the source institution computer system, the electronic transaction instructions causing the source institution computer system to execute the transfer; generating, by the one or more transaction management computers, an electronic notification of the transfer; and transmitting, by the one or more transaction management computers to the client device, the electronic notification of the transfer. Such a system may perform other cash sweep transactions that bypass source and/or destination institution cooperation.

Referring to FIGS. **7**A-**7**D, interfaces for a client device are illustrated. FIG. **7**A illustrates embodiments of an interface listing multiple client source accounts (note that the Source Accounts button **702** is activated in FIG. **7**A). An Add Account button **710** may initiate a process to add a new source account. In the exemplary embodiment, activating this Add Account button **710** will open the screen shown in FIG. **7**B comprising a block **720** to input a source institution (e.g., via text entry, searching, selecting from a predefined list, to name a few). A source account number may be input in a block **722**. A user's login credentials for the source account may also be input, such as in a block **724** for the client's username and a block **726** for the client's password. A Submit button **728** and a Cancel button **730** are also provided in the interface to complete the add account process and to cancel the process, respectively. In embodi-

ments, a confirmation process may be performed to verify the account credentials. For example, the TMS **120** may attempt to access the account and obtain account balance information, and/or the TMS **120** may perform a test transaction.

FIG. **7**C illustrates embodiments of an interface listing multiple client destination accounts, which may be depository accounts (note that the Destination Accounts button **704'** is activated in FIG. **7**C). The interface comprises an Add Account button **710'** to initiate a process to add a new destination account. Activating this Add Account button **710'** will open the screen shown in FIG. **7**D with a block **720'** to enter (e.g., input, search for, and/or select) a destination institution, a block **722'** to enter a destination account identifier (e.g., an account number), a block **724'** to enter a client username, and a block **726'** to enter a client password. A Submit button **728'** and a Cancel button **730'** are also provided in the interface.

Referring to FIG. **8**A, illustrated are embodiments of a Website interface **800** (e.g., accessible at a URL via a web browser) for accessing a user's transaction management account associated with the TMS **120**, e.g., to access account information and/or change settings. Activating the "Home **802**" element navigates to a home page (shown in the figure). In embodiments, the Home page interface may show a log of TMS transaction activity, such as a log of money movements, time of the transactions, the accounts involved, the amounts transferred, any fees incurred, etc. In embodiments, such information may be provided on a different webpage associated with the TMS.

In embodiments, the Website interface **800** may comprise a Source Accounts **804** element to access an interface for listing the client's source accounts (view accounts, view account balances, view account activity log, to name a few). In embodiments, the Website interface **800** may comprise a Destination Accounts **806** element to access an interface listing the client's destination accounts. In embodiments, the Website interface **800** may comprise a Transaction Settings **808** element to access an interface for creating, setting, and/or editing client transaction rules. In embodiments, the Website interface **800** may comprise a TMS Account **810** element to access and adjust TMS administration information, e.g., a logout option, billing information, contact information, financial information, and change TMS password, to name a few.

Referring to FIG. **8**B, embodiments of the Source Accounts **804** interface are illustrated. In the Your Source Accounts box, individual client source accounts are listed. In embodiments, when one of the source accounts is selected, a button for a View History **836** screen may be provided, where an account transaction history may be accessed. In embodiments, this information may be obtained by accessing source account data from the source institution servers using the client source account credentials and parsing and/or reformatting this data for display at the TMS website, as previously described. In embodiments, this information may be obtained in whole or in part from electronic storage in the TMS **120**. In embodiments, an Edit Account **838** button may be provided to allow deletion of accounts and/or to allow changing source account credentials, which will update the source account credentials stored at the TMS in electronic storage **314**. In embodiments, the TMS may provide an electronic notification to one or more user devices when a source account cannot be accessed and/or may prompt a user to modify the credentials. A button to Add Source Account **832** may be provided to present an interface for adding a new source account.

When the Add Source Account **832** button is clicked, an Add Source Accounts interface is provided. See FIG. **8**C for exemplary embodiments of such an interface. Within this interface, block **842** allows entry of a source institution. Block **844** allows entry of a source account identifier (e.g., a source account number). Block **846** allows entry of a username for the source account, and block **848** allows entry of a password for the source account. In embodiments, an account name may be input to facilitate identification of the account for the user. A comparable interface may be provided for adding a new destination account.

When a particular one of the source accounts is highlighted in FIG. **8**B, and the Edit Account button is activated, then an Edit interface is provided. Embodiments of an Edit interface are shown in FIG. **8**D. Within the interface, block **852** allows entry of a modification of the source institution identifier (e.g., source institution account). Block **854** allows entry of a change of the source account identifier. Block **856** allows entry of a change of the username for the source account. Block **858** allows entry of a change of the password for the source account. Block **860** permits saving changes, block **862** cancels changes, and block **864** deletes an account.

Referring to FIG. **8**E, embodiments of the Destination Accounts **806** interface are illustrated. In the Your Destination Accounts box, individual client destination accounts are listed. In embodiments, when an individual destination account is selected, a button for a View History **876** screen may be provided where the destination account transaction history may be accessed using the account credentials obtained from the electronic storage **316** and parsed and/or reformatted for display at the TMS website. In embodiments, some or all of this account history data may be obtained from electronic storage at the TMS. In embodiments, an Edit Account **878** element (e.g., button) may be provided to allow deletion of accounts and/or to allow changing destination account information, such as account credentials. Changes to account information may be updated in the electronic storage **316**. An Add Destination Account **872** button may be provided to open an interface to add a new destination account. An interface comparable to FIG. **8**C may be provided for adding a new destination account. An interface comparable to FIG. **8**D may be provided for editing the destination account data.

Referring to FIG. **8**F, embodiments of a Transactions Settings **808** interface are presented.

These transaction settings are default and/or user-specified settings from which the TMS can generate electronic monitoring rules and/or electronic transaction rules. Listed below are example transaction setting types where a value may be input, an option selected, or a default setting used, to trigger generation of a rule using the setting. In embodiments, a setting may comprise a value (e.g., a threshold value), which may be an absolute value. In other embodiments, the value may be a proportion (e.g., percentage).

A Source Account Minimum Balances **882** setting is a minimum balance to be maintained in a source account. The TMS may create a rule to generate transfer instructions to transfer funds from a destination account to the source account to maintain this balance. This threshold minimum balance may be set for each source account individually, or may be used for all accounts. In embodiments, one or more destination accounts may be set for each of the source accounts, or a default one or more destination accounts may be set from which to transfer funds to maintain the source

account minimum balance. In embodiments, the threshold minimum balance may be an absolute value or a percentage, e.g., of the account balance.

A Source Account Maximum Balances **884** setting is a maximum balance to be maintained in a source account. Based at least in part upon this threshold, the TMS may generate a rule to perform a subtraction operation or threshold comparison operation to determine when there is an excess amount in the source account over this source account maximum balance threshold, and/or to determine a corresponding excess amount. The rule may then initiate generation of instructions to transfer funds from the respective source account to a client destination account to remove the excess amount. In embodiments, this threshold may be set for each source account.

A Source Account Target Balance **886** setting is a target balance to be maintained in the source account. In embodiments, setting the target balance value may generate a rule to provide an electronic notice to the client device if the source account balance is less than this threshold. In embodiments, violating this target balance (e.g., via one or more executed or pending transactions) may initiate a transfer of funds to restore the target balance.

A Destination Account Minimum Balances **888** setting is a minimum balance to maintain in a destination account. Based at least in part upon this value, the TMS may generate a rule to prevent transfer from this destination account if the transfer transaction will cause the selected destination account balance to drop below the destination account minimum threshold. In embodiments, the TMS **120** may transfer from multiple destination accounts (e.g., according to a predefined order and/or a default order) to avoid violating the destination account minimum balance rule. Thus, the next destination account in an ordered list may be selected by the TMS, when the minimum balance will be violated for a given destination account. The destination account minimum balance threshold may be set for each destination account.

An Account Monitoring Frequency **890** setting may determine how often the TMS **120** monitors the source and/or destination accounts (e.g., once per day, twice per day, every hour, and/or every 5 minutes, to name a few) and/or specific times at which to monitor accounts (e.g., 9 am and/or 5 pm, market open, market close, to name a few). In embodiments, the setting may comprise an instruction to obtain account information following a transaction. This may be a default electronic instruction for the TMS **120**.

A Transaction Frequency **892** setting may determine how often the TMS will initiate transfer transactions (e.g., as necessary, no more than once per day, cap of 5 transactions per month, to name a few).

A Default Destination Account **894** setting may allow the client to select a default destination account and/or a default order of destination accounts (e.g., if the first account is insufficient or a transfer will violate a destination account minimum balance rule, then the TMS may use a second account in the order, etc.). In embodiments, a rule may be set to transfer from two accounts a set percentage or amount.

A Source-Destination Account Links **896** setting provides links between source and destination accounts. For example, three source accounts may be linked to one destination account, while a fourth source account may be linked to a second destination account. Thus, in embodiments, the TMS may perform transactions, as described herein, between a source account and the one or more destination accounts to which it is linked in the TMS.

In embodiments, one or more of the intermediary computers may comprise a client computer. The one or more databases may comprise computer storage on the client computer to hold the client authentication data for the source institution computer system and the client authentication data for the one or more destination institution computer systems. In embodiments, accessing the client authentication data for the source institution computer and/or accessing the client authentication data for the one or more destination institution computers may be triggered/permitted only by authentication of the client by matching a predetermined security program, e.g., an iris scan, a fingerprint scan, and/or a voice sample to data held in the computer storage of the client computer.

In embodiments, a further operation of the TMS **120** may comprise associating, by the one or more intermediary computers, an insurance contract with a user's TMS account to insure against unauthorized transfers from the source account or the one or more destination accounts, when the predetermined security program is used to limit access to the client computer. In embodiments, a comparison operation may be performed of the amount of the net buy order and an insured amount limit, and if the insured amount limit is exceeded, then in embodiments, the transaction may be automatically terminated, or in embodiments an electronic notification may be sent to the client that the amount of the buy order exceed the insurance limit.

In embodiments, the client authentication data for the source institution computer of a source institution and the client authentication data for the one or more destination institution computers of one or more destination institutions may limit authorization only to transfers between client accounts associated with the source institution computers and the destination institution computers and no other transfers (e.g., no transfers to accounts not associated with the client or not registered with the TMS as such). An interface may be provided to insert this transfer limitation into any transfer instructions. In embodiments, it may be a default setting. Accordingly, the process may further comprise generating and/or verifying compliance with electronic transaction authorization rules.

In embodiments, the process may further comprise triggering an association, by the one or more computers, of an insurance contract to insure against unauthorized transfers from the source account or the one or more destination accounts, to a fund transfer when the limited authorization for fund transfers is activated.

In embodiments, the electronic authorization from the client is utilized along with their passwords and appropriate identification to retrieve source account (e.g., brokerage account) information and destination account (e.g., cash management account) information on a timely basis to move funds back-and-forth as needed to cover a trade and/or to maximize yield or maximize interest on a cash management account by directing the movement of funds among accounts across institutions while bypassing/inactivating the automatic fund transfer programs of clearing firm computers, and/or source institution computers and/or destination institution computers (and the attendant processing time and/or expense) at the computer systems of the clearing firms, the source institutions, and the destination institutions.

When a retail client provides their identification information and access information to the service provider associated with the TMS **120**, the service provider may access data directly from the computer systems of the brokerage, money, and/or cash management providers. If the computer systems cannot be accessed directly the service provider (e.g., via the

TMS **120**) can use screen scraping or any other similar technology to access the respective clients account at the brokerage firm and/or at the cash management provider to retrieve appropriate account information. This account information may then be uploaded into a software program that determines an amount of money to be moved, from which account, and into which account, but bypassing/inactivating any the automatic fund transfer programs of clearing firm computers, and/or source institution computers and/or destination institution computers. The result of this automatic fund transfer bypass operation is that the client may be able to achieve a higher interest rate or yield on its cash management investments that are connected to the brokerage account and may eliminate attendant processing.

FIGS. **9**A-C are exemplary screen shots of transaction notifications in accordance with embodiments of the present invention. The notifications may comprise destination institution management graphical user interfaces. The notifications may indicate to a sweep system customer, such as a deposit sweep system customer, that at least a portion of the customer's funds will be moved to a particular destination institution, such as a depository institution, which may be a depository institution not previously used to hold the customer's funds or not pre-approved by the customer. In embodiments, a customer may not want funds transferred to the particular depository institution for a variety of reasons, such as the existence of additional accounts at that depository institution, which could leave a portion of funds uninsured for being over an insurance limit. Exemplary processes for providing customer control in automated sweep operations, including deposit sweep operations, via at least destination institution management graphical user interfaces are described herein with respect to FIGS. **13**A-**13**C-**2**.

FIG. **9**A illustrates a first exemplary notification, which may be provided to a user electronic device, such as a mobile device. The notification **902** indicates that a portion of a user's funds will be moved to a particular bank, e.g., Bank B, which may be a different depository institution than previously used for funds of the deposit sweep customer (or other cash sweep customer). The exemplary notification **902** includes an approve option **904** and a reject option **906**, which may be graphically rendered elements and/or hyperlinks. A user may select the approve option **904** to allow the deposit sweep transaction (or other respective cash sweep transaction) to proceed with a movement of the user's funds to the indicated depository institution. In embodiments, the interface may include a transfer amount input element (e.g., a text entry box, a drop-down menu, to name a few), by which the user can specify an amount of funds to allocate and/or transfer to the different depository institution or by which the user can specify a maximum permissible amount of funds to allocate and/or transfer. The user may instead select the reject option **906** to block the transfer, in which case the deposit sweep computer system (or other respective cash sweep computer system) may compute one or more potential reallocations of funds that would exclude the user's funds from the indicated depository institution. Upon selection of a reject option **906**, the system may display an interface with alternate depository institution selection options or input options, as illustrated in FIG. **9**B. A notification **902** may be a push notification, which may be displayed on a user electronic device, such as a mobile device. In embodiments, the notification **902** may comprise an email, text message, other electronic message, and/or automated telephone call, to name a few.

FIG. **9**B shows an exemplary depository institution selection interface **910** in accordance with the present invention. Upon receipt of a user selection of a reject option a client device may display such a selection interface. The interface **910** may request that a user select or input one or more other depository institutions, e.g., banks, where that user's funds may be deposited during a deposit sweep or other cash sweep operation. According the interface **910** may include one or more input elements or selection elements **912** identifying depository institutions available for deposit of the user's funds. Display data indicating the available depository institutions may be received from a transaction management system, which may determine the institutions that have capacity for the user's funds. In embodiments, a plurality of depository institutions, e.g., Bank F and Bank G, may be required to satisfy deposit sweep transaction parameters for a particular deposit sweep operation, and a combination of depository institutions may be presented to a user for selection, as seen from selection option **912-4**. The interface **910** may include transfer amount input elements, which may be maximum permissible transfer amounts, for each respective available and/or alternative depository institution.

FIG. **9**C illustrates a second exemplary notification, which may be provided to a user electronic device. The notification **916** may indicate that a portion of a user's funds will be moved to a particular depository institution unless the user takes an action to prevent the transfer. In embodiments, the notification may provide a time limit within which the user must act to prevent the transfer successfully. The notification **916** may comprise instructions on how to prevent the transfer, a selectable option (e.g., a rendered GUI element, such as a button) to prevent the transfer, and/or a selectable hyperlink to prevent the transfer, to name a few. In embodiments, the notification **916** may be an informational notification only, providing an indication that at least a portion of the customer's funds have been allocated to a different depository institution, but not providing a mechanism for the user to object to the allocation.

In embodiments, sweep notifications may be provided to indicate that a sweep transaction occurred. Such sweep notifications may include balance information, such as post-sweep balances at one or more institutions and/or pre-sweep balances.

FIGS. **10**A-C are schematic diagrams of secure authentication system architectures in accordance with exemplary embodiments of the present invention. A secure authentication system may provide security designed to ensure that one or more user electronic requests associated with cash sweep process, such as deposit sweep processes, originated from a valid authorized user. Such an authorized user may be a sweep customer, an individual (e.g., manager, administrator, employee, and/or agent) associated with a source or destination institution, and/or an individual associated with a cash sweep program, to name a few. Such a secure authentication system may avoid pure biometric comparisons, as biometric signatures cannot be changed if compromised. The secure authentication system may also avoid storing reference user credentials, such as passwords, biometric reference data, or other identifying or secret information. In embodiments, any of the modules described herein may perform one or more functions described with respect to other modules. In embodiments, any of the functions herein may be performed, in whole or in part, by one or more additional modules.

In embodiments, the security systems, methods, and program products described herein may be applied to non-sweep processes to provide secure authorization, e.g., for electronic messages, and/or to provide data security. The

present invention is an improvement over the prior art security systems and methods that require either pure biometric signatures or storage of user credentials, such as reference credentials (e.g., user passwords, PINs, biometric data, security questions and/or corresponding answers, to name a few), and as such, the technological improvement can have far-reaching applications to enhance data security, message authentication, and/or data transmission security.

FIG. **10**A shows a first embodiment of an exemplary secure authentication system. Secure data may be contained within and processed within a secure enclave processor core **1006**, which may be one or more processor cores or portions thereof, e.g., isolated or partitioned from other non-secure system components. The Apple A7 processor with a Secure Enclave is an example of a prior art secure enclave processor. The secure enclave processor core **1006** of the present invention is an improvement over such existing secure processors. The processor core **1006** includes a novel input into the processor for electronic messages targeted for encryption. In embodiments, the secure enclave processor core **1006** may be isolated via hardware separation and/or software separation. It may have limited data pathways (e.g., circuitry, wiring) to and/or from the core. The secure enclave processor core **1006** may receive password input data from an input device **1002**. Password input data may comprise alphanumeric sequences or numeric sequences (such as a personal identification number (PIN)), to name a few. The input device **1002** may comprise a keyboard, mouse, keypad, touch screen, microphone, camera, or video camera, to name a few. The secure enclave processor core **1006** may also receive biometric data from a biometric reader or scanner, such as a fingerprint scanner **1004**. Biometric data may comprise images (e.g., facial images, fingerprint images, palm images, retinal images, iris images), scans, thermal mappings, and/or voice samples, to name a few. In embodiments, the secure enclave processor core **1006** may receive data from other system components, such as a normal processor core **1008**. Such data may comprise message data targeted for encryption by the secure enclave processor core **1006**. In embodiments, a single data pathway may connect the normal processor core **1008** to the secure enclave processor core **1006**. In other embodiments, there may be a single pathway into the secure enclave processor core **1006** and a separate pathway from it.

The secure enclave processor core **1006** may comprise non-transitory computer-readable memory having stored thereon one or more software modules configured to run on the secure enclave processor core **1006**. Such modules can include a biometric data processing module **1010**, a private key generation module **1012**, an encryption module **1014**, and/or a secure data deletion module **1016**. In embodiments, the non-transitory computer-readable memory may store, e.g., during processing, sensitive data such as password information, biometric data, and/or private keys.

A biometric data processing module **1010** may apply one or more algorithms, such as wavelet transformations, Fourier-Mellin transformations, other integral transformations, log-polar transformations, filtering (e.g., high pass and/or low pass filtering), encoding (e.g., base-36 encoding), and/or other operations to transform and/or convert received biometric data. The biometric data processing module **1010** may extract second biometric data from the received biometric data, where the second biometric data is designed to be unique to a user but able to be replicated from each of multiple instances of user-specific biometric data. In embodiments, the biometric data processing module **1010** may generate a feature vector from the biometric data, which may be an invariant feature vector. In embodiments, the module may generate a coding of the invariant feature vector, such as a 128-bit code, which may be designed to be an invariant code. In embodiments, additional input information, such as a PIN, may be used in the generation of an invariant feature vector or corresponding code, e.g., to increase the variation in output from one user to the next.

A private key generation module **1012** may generate a private key, e.g., based at least in part upon the biometric data. The private key generation module **1012** may also use a password or PIN number in generating the private key. The private key may be used in a public key or asymmetric key cryptography security system. In embodiments, the private key generation module **1012** may also generate a public key corresponding to the private key. The public key may be generated upon the first generation of the private key, and the public key may be stored on the user electronic device or transmitted to one or more other entities, such as a deposit sweep computer system or other cash sweep computer system. A public key may represent non-secure information that can be used to verify the validity of generated private keys that should correspond thereto. Accordingly, a public key stored on the user electronic device may be used to determine, at the device, a user's authorization to use the device or to engage in one or more secure transactions or operations. In embodiments, a public key stored on the user electronic device may be used to determine whether a correct private key was generated, e.g., prior to using the private key to encrypt an electronic message. A public key stored at a remote computer system may be used to confirm authorization for received electronic requests signed using the private key, e.g., so as to generate a digital signature.

An encryption module **1014** may use the generated private key to encrypt one or more electronic messages and/or to provide an indication of authenticity of one or more electronic messages, such as by providing a digital signature based at least in part upon the private key. In embodiments, the encryption process may comprise hashing an electronic message payload to produce a message digest and encrypting the message digest using the private key, which functions as a private signing key. The encrypted message digest may comprise a digital signature. The encrypted message may be decrypted and/or the digital signature may be verified using a corresponding public key, which functions as a public verification key.

A secure data deletion module **1016** may delete from any memory devices of the client device **112**, and more specifically any non-transitory computer-readable memory within the secure enclave processor core **1006**, any secure information, such as a user password, biometric data, processed biometric data (e.g., biometric images or versions thereof that were generated using one or more algorithms) and/or private key data. The secure data deletion module **1016** may perform multiple delete and/or overwrite operations to ensure that even partial copies of sensitive data do not remain in memory.

A normal processor core **1008** may run other software modules used by a client device, which can include a message generation module **1018** and a communications module **1020**. A client device **112** may comprise one or more normal processor cores **1008**.

A message generation module **1018** may generate one or more electronic messages, which can comprise user requests, user instructions, and/or user information. The messages may be unencrypted when generated. Such electronic messages may be configured to be transmitted via a

communications network, such as a data network. Accordingly, messages may be transmitted as one or more data packets.

A communications module **1020** may be configured to send and/or receive electronic messages, data, and/or data packets. Such messages can comprise push notifications, alerts, emails, and/or SMS messages, to name a few. The communications module **1020** may transmit one or more electronic messages, which may be unencrypted or encrypted, to one or more user electronic devices or computer systems. The communications module **1020** may use hardware and/or software that comprise a communications portal, as described herein.

FIG. **10**B shows a second embodiment of an exemplary secure authentication system. The figure illustrates exemplary data pathways, e.g., among software modules. The data pathways may comprise computer-readable instructions to transmit data from one module or device to another and/or to fetch data from a particular module or device. In embodiments, certain data pathways may comprise hardware components, such as wire, e.g., copper wire, circuitry, printed circuitry, and/or hardware sockets and plugs. Multiple data types may flow along a given hardware pathway. For example a single hardware connection between the normal processor core **1008** and the secure enclave processor core **1006** may allow electronic messages targeted for encryption to be sent from the normal processor core **1008** (e.g., from the message generation module **1018**) to the encryption module **1014** and may allow encrypted electronic messages to be sent from the encryption module **1014** to the normal processor core **1008** (e.g., to the communication module **1020**). In other embodiments, a plurality of hardware connections, which may be dedicated pathways, may be employed.

As shown in FIG. **10**B, user credential information, such as a user password, PIN, and/or username, may be input into the biometric data processing module **1010** from an input device **1002**. In embodiments, an intermediate input device processing module may receive data from the input device **1002** and pass it to the biometric data processing module **1010**. Biometric data, such as a biometric image or other biometric reading data, may be input into the biometric data processing module **1010** from a biometric reader device, such as fingerprint scanner **1004**. The biometric data processing module **1010** may generate an invariant feature vector based at least in part upon the input biometric data and/or the input user credential information.

The feature vector may be passed from the biometric data processing module **1010** to the private key generation module **1012**. In embodiments, user credential information may also be passed from the biometric data processing module **1010** to the private key generation module **1012**. In other embodiments, the user credential information may be passed to the private key generation module **1012** from the input device **1002** or from an intermediate input device processing module. The private key generation module **1012** may generate an invariant asymmetric private key, which it may pass to the encryption module **1014**.

The encryption module may use the private key to encrypt or digitally sign an electronic message received from the message generation module **1018**. The encrypted or signed electronic message may then be provided to the communication module **1020** from the encryption module.

FIG. **10**C shows another exemplary embodiment of an exemplary secure authentication system. Data may flow within the system similar to the embodiment illustrated by FIG. **10**B. However, within the secure enclave processor core **1006** a message security evaluation module **1022** may receive any data passed to the secure enclave processor core **1006** from the one or more normal processor cores **1008**. The message security evaluation module **1022** may analyze electronic messages targeted for encryption that are received at the secure enclave processor core **1006**, e.g., to ensure that the messages comply with preapproved data formats and/or to perform preliminary authentication of the messages, which may reduce the risk of introducing malicious code, e.g., viruses, into the secure core **1006** and/or may reduce the risk of encrypting and transmitting unauthorized electronic messages not provided by an authorized user. In embodiments, the message security evaluation module **1022** may require input of user credentials, such as a password, to authenticate a message prior to encrypting and transmitting to other devices or computer systems. The message security evaluation module **1022** may be isolated from the remainder of the contents of the secure enclave processor core **1006**, except for a data pathway to transmit verified messages targeted for encryption to the encryption module **1014**. Once a message is authenticated it may be passed to the encryption module **1014** for encryption and/or digital signature.

FIG. **11**A illustrates data flow among components of a client device **112** and steps performed by each component in a secure data authentication process associated with deposit sweep or other cash sweep transfer operations. The steps performed are described herein with respect to FIGS. **11**B-D. A biometric data processing module **1010** may receive a user password from an input device **1002** and may receive biometric data from a biometric reader device, such as a fingerprint scanner **1004**. The biometric data processing module **1010** may generate an invariant code based at least in part upon the biometric data and the user password, e.g., by performing steps S**1102**, S**1104**, S**1106**, and S**1108**. Such processes may comprise biohashing. Biohashing is described in Andrew Teoh Beng Jin et al., *Biohashing: two factor authentication featuring fingerprint data and tokenised random number*, Pattern Recognition 37 (2004) 2245-2255 and in Loris Nanni & Alessandra Lumini, *Empirical tests on BioHashing*, Neurocomputing 69 (2006) 2390-2395, the contents of each of which are incorporated by reference as if fully set forth herein.

The biometric data processing module **1010** may pass the invariant code to a private key generation module **1012**. The biometric data processing module **1010** may also pass the user password to the module **1012**, although in embodiments the private key generation module **1012** may obtain the password from the input device **1002**. The private key generation module **1012** may perform step S**1110** to generate an asymmetric private key. The private key generation module **1012** may pass the private key to an encryption module **1014**. The encryption module **1014** may obtain a message targeted for encryption or digital signature, e.g., from a message generation module **1018**. In embodiments, the electronic message targeted for encryption or digital signature may be initially unencrypted. In other embodiments, it may already be encrypted using encryption techniques that do not involve the private key. The encryption module **1014** may encrypt or digitally sign the electronic message by performing step S**1112**. The encryption module **1014** may pass the encrypted or digitally signed electronic message to a communications module **1020**, which may transmit the encrypted or digitally signed electronic message to other devices and/or computer systems in a step S**1114**. A secure data deletion module **1016** may execute step S**1116** to remove sensitive data, such as the user password, input biometric data, processed biometric data, private key, and/or

encrypted or signed electronic message from the memory devices of the client device **112**.

This secure data authentication system and processes eliminate the need to store secure data at all, whether locally on the client device or remotely, such as on computer servers. Encryption or digital signature is provided using a private asymmetric key, which is regenerated either each instance it is needed or for each user session. User sessions may time out after a particular period of time, and/or the secure data deletion module **1016** may be configured to delete any sensitive data after a predefined period of time.

Unlike security systems in the prior art, the system and processes of the present invention do not store reference user credentials or reference biometric data to be matched against user credentials or biometric data that is input for authentication of a user or a user electronic request. Instead, encrypted or digitally signed electronic messages may be verified using a public key corresponding to the private key that functioned as the signing key. The public key is not sensitive data or is less sensitive than user credential information and user biometric data. Accordingly, the public key may be stored locally on the client device and/or on remote servers, e.g., in non-transitory computer-readable memory operatively connected thereto, which remote servers may comprise a cash sweep computer system, which may be a deposit sweep computer system. Any illicit or accidental access to the public key cannot result in an unauthorized transfer. Meanwhile, the private key only exists within the secure enclave processor core **1006** and only for a limited period of time, e.g., during the pendency of the encryption operations or a user session. The private key cannot be extracted from the secure enclave processor core **1006** due to limited hardware data pathways and/or software barriers to extraction. These aspects of the security system of the present invention provide key advantages over prior art security systems.

The secure data authentication system and processes of the present invention further improve on prior art public key cryptography systems that seek to introduce entropy into private key generation to decrease the probability of regeneration of the private key. Prior art private keys must be stored, e.g., in a security token device, in a computer file, memorized, and/or written down, to name a few. Stored private keys are susceptible to loss, theft, and/or accidental disclosure. The present invention provides technical mechanisms for regenerating a private key based at least in part upon biometric data, which eliminates the need to store the private key. An invariant, replicable, unique representation of a user's biometric data is generated from the input biometric data. That invariant representation is then used to generate a private key. The invariant feature extraction processes and/or the private key generation process may be further based at least in part upon user password information, such as a numeric passcode or PIN. Accordingly, a user may regenerate a private key as needed to authenticate an electronic request or to provide other authentication.

FIGS. **11**B-D are flow charts of exemplary processes for performing cash sweep operations, such as deposit sweep operations, securely. In embodiments, a security protocol module at the client device may be activated to perform encryption and/or digital signature processes, as described herein. The security protocol module may be activated upon a user electronic request to transmit sweep transaction data, instructions, or requests, which require authentication or encryption, or upon receipt of other user requests at the client device, such as requests to access account information associated with a customer account at a cash sweep management system (e.g., a deposit sweep management system), at a source institution, and/or at a destination institution, to name a few. In embodiments, the security protocol module may be activated upon input of user biometric information and/or access of or activation of a biometric reader device by the user.

Referring to FIG. **11**B, in a step **S1102**, a mobile device may receive a user password via a graphical user interface rendered on the mobile device. The mobile device may be a client device, as described herein, such as a cell phone, smart phone, personal digital assistant, or tablet computer, to name a few. The graphical user interface may be a login interface or other interface with rendered user credential input elements. The user password may be input using a user input device, such as a keyboard, keypad, touch screen, touchpad, pointer device, mouse, or microphone, to name a few. The user password may be a series of digits, such as a numeric passcode or personal identification number, which defines a number. In embodiments, the user password may be an alphanumeric sequence. An alphanumeric sequence may be encoded to convert it to a numeric sequence. In embodiments, an alphanumeric user password may be converted to binary data using base-36 encoding.

In a step **S1104**, the mobile device may capture into a secure enclave processor core of the mobile device using a biometric reader embedded in the mobile device, a first digital biometric image of a biometric reading of a user. The biometric reader may be a scanner such as a fingerprint scanner, hand or palm scanner, retinal scanner, iris scanner, blood sampler, or voice scanner to name a few. In embodiments, the biometric reader may be a capacitive scanner (e.g., a capacitive fingerprint scanner) that can use electrical current to determine ridges and valleys, e.g., based at least in part upon detected voltage outputs. In embodiments, the biometric reader may be an optical scanner that can use light (e.g., emitted from a diode) and measure the intensity of reflection, e.g., to determine distances to surface points and/or elevations thereof. The secure enclave processor core may only be accessible to input passwords, digital biometric image data, and electronic messages targeted for encryption or digital signature, and further accessible to receive outputs of encrypted or digitally signed electronic messages and public keys configured to verify the authenticity of encrypted electronic messages.

In a step **S1106**, the secure enclave processor core may convert the first digital biometric image into an invariant biometric feature vector using an integrated wavelet and Fourier-Mellin transformation process. An exemplary particular process by which the invariant biometric feature vector may be generated is illustrated in FIG. **11**C, described herein.

In embodiments, e.g., prior to converting the first digital biometric image in the invariant biometric feature vector, the secure enclave processor core may convert the first digital biometric image into a distorted first digital biometric image, which may comprise a sixth digital biometric image. To do so the secure enclave processor core may apply a distortion to the first digital biometric image, such as by applying a distortion algorithm, which may produce a radial distortion, such as a barrel distortion (e.g., fisheye distortion), pincushion distortion, or mustache distortion. The distortion may be based at least in part upon the user password. For example, the user password may be used to select a particular distortion algorithm (e.g., from a predefined set of distortion algorithms) or parameters therefor. Accordingly, a numeric value may be derived from the user password (e.g., via encoding and/or by treating a numeric

passcode as a number) and used, e.g., in conjunction with logical programming rules, to select an algorithm and/or set algorithm parameters. In embodiments, the user password may provide an input to a distortion algorithm to indicate a center of distortion, e.g., by selecting a location, such as a pixel location, associated with the center of distortion, which location may be based at least in part upon the numeric value derived from the user password. The sixth digital biometric image produced using the distortion algorithm may be converted into an invariant biometric feature vector in place of the first digital biometric image, using the process described in FIG. **11**C.

In a step **S1108**, the secure enclave processor core may convert the invariant feature vector using the user password into a 128-bit invariant code. In embodiments, the invariant code may be a binary series. Although the process is described with respect to a 128-bit code, in embodiments, other bit counts may be used, e.g., 64 bits, 256 bits, 512 bits, 1024 bits, 2048 bits, 4096 bits, to name a few. The invariant code may provide a seed for generation of a private key. An exemplary process for generating the invariant code from the invariant biometric feature vector is illustrated in FIG. **11**D, described herein.

In a step **S1110**, the secure enclave processor core may generate an invariant asymmetric private key using the 128-bit invariant code. In embodiments, the secure enclave processor core may also use the user password to generate the private key. In embodiments, a key generation algorithm, such as an RSA algorithm or a Digital Signature Algorithm (DSA) (e.g., as described by the FIPS 186-3 standard or the FIPS 186-4 standard), may be used to generate the private key. In embodiments, the invariant code may comprise a seed input into a cryptographically secure pseudo-random number generator, the output of which may be processed by an RSA or other key generation algorithm. In embodiments, the user password may be used to modify the invariant code, such as by using the user password to cipher the invariant code, e.g., to offset the invariant code or the digits thereof, as a multiplier of the invariant code or the digits thereof, and/or to prepend, insert, or append the user password to the invariant code (e.g., optionally first converting the password to binary). The modification of the invariant code may be made prior to input of the modified invariant code into a key generation algorithm.

In a step **S1112**, the secure enclave processor core may apply the invariant asymmetric private key to an electronic message associated with a cash sweep transaction, which may be a deposit sweep transaction, to generate a digitally signed electronic message comprising a message payload and digital signature to be securely transmitted to a second device associated with the sweep transaction. In embodiments, the second device may be any of a sweep computer system (e.g., a deposit sweep computer system), a source institution computer system, a depository institution computer system, or another destination institution computer system (e.g., an ETF computer system or money fund computer system, to name a few). In embodiments, the message payload may comprise a request to perform a particular sweep operation, user information such as account credentials associated with sweep operations, and/or authorization to perform a particular sweep operation, which may be a cash sweep operation, such as a deposit sweep operation or a sweep involving non-depository accounts, such as ETFs, money funds, stable value funds, or capital investment plans, to name a few. The digital signature may be generated using the invariant asymmetric private key with a public key cryptography algorithm. For example, the secure enclave processor core may hash the message payload to produce a message digest and then may encrypt the message digest using the invariant asymmetric private key.

Applying the invariant asymmetric private key to an electronic message can comprise receiving, at the secure enclave processor core from a normal processor core, the electronic message. The secure enclave processor core may then evaluate the electronic message, e.g., to verify the message data format, which may be a protection against introducing malicious code into the secure enclave processor core. The secure enclave processor core may then generate a message digest by computing a hash of the message payload and then may encrypt the message digest using the invariant asymmetric private key.

In a step **S1114**, the mobile device may securely transmit to the second device the digitally signed electronic message causing the sweep transaction to be initiated upon successful verification of the digital signature using a corresponding public key previously provided to the second device, wherein the corresponding public key corresponds to the invariant asymmetric private key. In embodiments, the public key may be generated upon the first generation of a private key and then provide to other devices, such as the second device. In embodiments, a copy of the public key may be maintained at the mobile device, e.g., stored in non-transitory computer-readable memory. The mobile device may use such a stored public key to verify subsequent instances of generation of the private key to ensure the private key was generated accurately prior to signing electronic messages with it.

In a step **S1116**, the secure enclave processor core may permanently delete the user password, the first digital biometric image, the second digital biometric image, the third digital biometric image, the fourth digital biometric image, the fifth digital biometric image, the first set of feature data, the invariant biometric feature vector, the invariant asymmetric private key, and the 128-bit invariant code.

FIG. **11**C shows an exemplary process for converting a digital biometric image into an invariant biometric feature vector. The digital biometric images that are generated and processed in this process may comprise biometric data and/or image data, such as pixels, pixel position data, pixel values (e.g., brightness or light intensity values), and/or color values, to name a few.

In a step **S1106*a***, the secure enclave processor core may apply a wavelet transformation to the first digital biometric image to generate a second digital biometric image. In embodiments, a discrete wavelet transformation may be applied.

In a step **S1106*b***, the secure enclave processor core may apply a fast Fourier transform to the second digital biometric image to generate a third digital biometric image. The third digital biometric image may thus be a representation of the second digital biometric image in the frequency domain.

In a step **S1106*c***, the secure enclave processor core may apply a log-polar transformation to the third digital biometric image to generate a fourth digital biometric image. A representation of the third biometric image using log-polar coordinates may be used to adjust for rotational variations in the input biometric data, e.g., if a fingerprint was scanned at a rotated angle, and/or to adjust for differences in scale, e.g., if the scanned sample was closer or farther from the biometric reader, such as if a finger was pressed firmly against the reader instead of being held a short distance away.

In a step **S1106*d***, the secure enclave processor core may apply a high pass filter to the fourth digital biometric image to generate a fifth digital biometric image. The high pass

filter may reduce noise in the image data. The filter may eliminate image data with values below a predefined threshold value.

In a step **S1106***e*, the secure enclave processor core may apply a fast Fourier transform to the fifth digital biometric image to generate a first set of feature data. In embodiments, the feature data may comprise a series of values.

In a step **S1106***f*, the secure enclave processor core may apply row concatenation to the first set of feature data to generate an invariant biometric feature vector.

FIG. **11**D shows an exemplary process for converting the invariant feature vector into a 128-bit invariant code.

In a step **S1108***a*, the secure enclave processor core may generate, using the user password, a threshold intensity value. In embodiments, the threshold intensity value may be scaled or normalized within a predefined intensity range. For example, a four-digit passcode may have 5,040 permutations in the range 0000 to 9999. A user password that is a four-digit passcode may be scaled from that range to a scaled range, such as 0 to 255, which range may correspond to possible image intensity values. In embodiments, the user password may be normalized within the range of values of the invariant feature vector elements or within the range of permissible values of the invariant feature vector elements. The normalized user password may then be used as a threshold intensity value.

Accordingly, generating the threshold intensity value may comprise obtaining a numeric value from the user password (e.g., by treating an input numeric sequence as a number or by encoding an alphanumeric sequence) and then normalizing that numeric value within a predefined intensity range of possible intensity values by scaling the numeric value based at least in part upon a relation between a range of possible numeric values and the predefined intensity range.

In a step **S1108***b*, the secure enclave processor core may apply the threshold intensity value to the invariant feature vector to generate an invariant code, such as a 128-bit invariant code. If an element of the invariant feature vector is less than the threshold intensity value, the corresponding element in the invariant code may be assigned a value of zero. If the element of the invariant feature vector equals or exceeds the threshold intensity value, the corresponding element in the invariant code may be assigned a value of one. In embodiments, the zeros may be assigned to elements greater than the threshold intensity value, while the ones may be assigned to elements less than or equal to the threshold intensity value. The resulting invariant code may be a series or vector of ones and/or zeros.

In embodiments, applying the threshold intensity value to the invariant feature vector to generate the 128-bit invariant code can comprise generating, using the threshold intensity value, a sequence of real numbers comprising a set of pseudo-random vectors. The secure enclave processor core may then apply a Gram-Schmidt ortho-normalization to the set of pseudo-random vectors to transform them into an orthonormal set of vectors. In embodiments, the secure enclave processor core may normalize the invariant biometric feature vector, e.g., between the values negative one and positive one. The secure enclave processor core may compute an inner product between the invariant biometric feature vector and the orthonormal set of vectors. For each inner product value less than the threshold intensity value the secure enclave processor core may assign a value of zero to a corresponding element position in a binary vector, and for each inner product value greater than the threshold intensity value the secure enclave processor core may assign a value of one. Accordingly, the secure enclave processor core may map each assigned value to a bit location based at least in part upon the element location within the biometric feature vector. In embodiments, element locations with the biometric feature vector may have been determined using a log polar transformation. In embodiments, the secure enclave processor core may aggregate the values in their respective locations to produce a bit string. As such, the secure enclave processor core constructs an ordered sequence of zeros and/or ones based at least in part upon a comparison of the biometric feature vector element values to the threshold intensity value and a mapping of the element location to a location in the ordered sequence, which is the bit string.

In embodiments, a particular type of feature vector known as FingerCode may be generated as an alternative to step **S1106**. FingerCode generation is described in Dario Maio & Loris Nanni, *An efficient fingerprint verification system using integrated gabor filters and Parzen Window Classifier*, Neurocomputing 68 (2005) 208-216 and in A. K. Jain et al., *Filterbank-based fingerprint matching*, IEEE Trans. Image Process. 5 (9) (2000) 846-859, which are incorporated by reference as if fully set forth herein. Accordingly, a biometric image is input to a FingerCode feature extraction process. The biometric digital image may be preprocessed, e.g., filtered, to reduce noise and/or increase contrast. Then, in the feature extraction process a reference point or core point is determined, which may be the point of maximum curvature of concave ridges. To determine the reference point, the secure enclave processor core may, at least, divide the biometric image into a grid having any number of rows and columns. Then, it may compute a gradient at each pixel of the image. In embodiments, it may compute gradients in two perpendicular directions corresponding to the directions of the rows and columns. Then a local orientation may be computed at the center of each cell or sector of the grid to generate an orientation field. The orientation field may be smoothed, such as by low pass filtering, which may comprise converting the orientation field into a continuous vector field, which may be further processed to determine curvature.

Once a core point is determined, the digital biometric image may be divided into sectors. FIGS. **12**A-D illustrate exemplary selection of a core point **1208** on a digital biometric image **1202** for biometric feature extraction in accordance with exemplary embodiments of the present invention, as well as division of the digital biometric image into sectors **1206**. FIGS. **12**A-B illustrate sectors that are bands **1206***a* created using a polar coordinate system, while FIGS. **12**C-D illustrate Cartesian sectors **1206***c*. The digital biometric image may be divided into different numbers of sectors **1206**, such as 64, 128, 256, or 512 sectors, to name a few. Each sector may correspond to a vector element. In embodiments, a plurality of grids **1204** may be used and combined to generate a vector for more parameters (e.g., two 64-sector grids may be combined to generate a 128-element vector).

In embodiments, the core point may be shifted based at least in part upon the user password. For example, a numeric passcode may define a translation in the respective coordinate system. Accordingly, a passcode numeric value may be scaled to the image boundaries. In embodiments, a first portion of a passcode (e.g., the first three digits) may define a first translation parameter, such as a distance along a horizontal axis in the Cartesian system or a distance in the polar system, while a second portion of the passcode (e.g., the second three digits) may define a second translation parameter, such as a distance along a vertical axis in the

Cartesian system or an angle in the polar system, or vice versa, to name a few. The superimposed coordinate systems may comprise any number of sectors. In embodiments, each sector may be assigned to a position within a vector or array.

A value computed within a respective sector may be assigned to the respective position within the vector. In embodiments, values may be normalized between 0 and 9 and/or may be binary values. Pixel values within each sector may be normalized. In embodiments, one or more filters may be applied to each sector. In embodiments, filters such as Gabor filters may be applied in a plurality of directions, such as two, four, or eight directions, to name a few. Then, an average absolute deviation from the mean grey values in each sector may be computed. The resulting value may be assigned to a vector element position.

In embodiments, a system for generating a secure biometric-based cryptographic key without storing biometric information in order to authenticate data in a cash sweep (e.g., deposit sweep) transfer system can comprise one or more processors (e.g., of a mobile device) and non-transitory computer-readable memory having stored thereon instructions to perform the steps of receiving, via a first graphical user interface on a mobile device, a user password; capturing, using a biometric reader embedded in the mobile device, into a secure enclave processor core, a first digital biometric image of a biometric reading of a user, wherein the secure enclave processor core is only accessible to input passwords, digital biometric image data, and electronic messages targeted for encryption, and to receive from the secure enclave processor core encrypted electronic messages and public keys configured to verify the authenticity of encrypted electronic messages; converting, by the secure enclave processor core, the first digital biometric image into an invariant biometric feature vector using an integrated wavelet and Fourier-Mellin transformation process; converting, by the secure enclave processor core, the invariant feature vector using the user password into a 128-bit invariant code; generating, by the secure enclave processor core, an invariant asymmetric private key using the 128-bit invariant code and the user password; applying, by the secure enclave processor core, the invariant asymmetric private key to an electronic message comprising a message payload associated with a cash sweep transaction such as a cash sweep transaction to generate a digitally signed electronic message to be securely transmitted to a second device associated with the sweep (e.g., deposit sweep) transaction; securely transmitting, from the mobile device to the second device, the digitally signed electronic message causing the sweep transaction to be initiated upon successful verification of the digital signature using a corresponding public key previously provided to the second device, wherein the corresponding public key corresponds to the invariant asymmetric private key; and permanently deleting, from the secure enclave processor core, the user password, the first digital biometric image, the second digital biometric image, the third digital biometric image, the fourth digital biometric image, the fifth digital biometric image, the first set of feature data, the invariant biometric feature vector, the invariant asymmetric private key, and the 128-bit invariant code.

FIGS. **13**A, **13**-B-**1**-**13**-B-**2**, and **13**-C-**1**-**13**-C-**2** are flow charts illustrating various embodiments of methods for inserting remote customer control into automated cash sweep processes. The processes are illustrated with respect to deposit sweeps. In embodiments, similar processes may be implemented for other cash sweeps, which may involved destination institutions other than the depository institutions shown in the figures. The processes described therein utilize specially generated graphical user interfaces to provide deposit sweep customers with information regarding the depository institutions to which their funds are proposed to be allocated and/or transferred. The customers can approve the allocations or reject them. In embodiments, the customers, via the graphical user interfaces, may identify alternative depository institutions to which to allocate their funds and/or threshold amounts to transfer to particular depository institutions. Accordingly, the GUIs alter the technical operation of prior art deposit sweep processes, enabling new information and customer feedback mechanisms, which can alter the operation of the deposit sweep processes, such as allocations of funds.

FIG. **13**A is a flow chart of a process for performing deposit sweep transactions comprising providing customer control in an automated deposit sweep transaction in accordance with exemplary embodiments of the present invention.

In a step **S1302**, a deposit sweep computer system comprising one or more computers may receive a deposit sweep file for a deposit sweep program. The deposit sweep file may comprise transaction information. In embodiments, transaction information can comprise indications of transactions, which can include buy amounts, sell amounts, net transaction amounts, transaction fee amounts, pre-transaction balances, and/or post-transaction balances, to name a few. In embodiments, the deposit sweep computer system may obtain one or more transaction amounts and may separately obtain one or more account balances. The system may compute post-transaction account balances therefrom.

In a step **S1304**, the deposit sweep computer system may determine, based at least in part upon the transaction information, allocations of funds for a plurality of customers. The allocations may comprise identifications for each respective customer of one or more respective destination depository institutions and respective amounts to allocate to each respective destination depository institution. In embodiments, executing the allocations may comprise updating one or more electronic ledgers. In embodiments, executing the allocations may comprise transferring the respective amounts from a first account to a second account.

In a step **S1306**, the deposit sweep computer system may determine for a first respective customer that at least one of the one or more respective destination depository institutions is a different destination depository institution for the first respective customer. The different destination depository institution may not currently hold customer funds for the deposit sweep program for the first respective customer. In embodiments, the deposit sweep computer system may analyze historical transaction and/or account data to determine that whether a destination depository institution previously held customer funds. Accordingly, the deposit sweep computer system may determine different destination depository institutions that never held funds for the first respective customer or that did not hold such funds within a threshold period of time (e.g., 2 months, 6 months, 1 year, 2 years, 5 years). In embodiments, the deposit sweep computer system may determine different destination depository institutions based at least in part upon a comparison to a previous sweep transaction, e.g., the last sweep transaction involving funds of the first respective customer. Any depository institution not included in the previous sweep transaction may be flagged as a different depository institution for the current sweep transaction.

In embodiments, the deposit sweep computer system may determine different destination depository institutions that

do not currently hold any funds for the first respective customer, including funds outside the deposit sweep program, e.g., in non-program accounts. In embodiments, the deposit sweep computer system may use user credentials for the first respective customer to access account information and/or otherwise to determine whether any account exists for the first respective customer at the depository institution. Accordingly, the deposit sweep computer system may determine that the different destination depository institution does not have an existing account for the first respective customer. The deposit sweep computer system may access a database of customer preferences to determine whether the customer has pre-approved or pre-rejected a particular depository institution.

In a step **S1308**, the deposit sweep computer system may generate first machine-readable instructions (e.g., mark-up code, style code, image data, text data, interaction processing code such as JavaScript, to name a few) to render a destination institution management graphical user interface. The interface may comprise a different destination depository institution notification indicating that at least a portion of the customer funds are allocated to the different destination depository institution. The interface may further comprise a graphical accept option to approve the allocation and/or a graphical reject option to reject the allocation.

In embodiments, the destination institution management graphical user interface may identify the source account. The interface may include an indication of the amount of funds allocated or targeted for allocation to the different destination depository institution for the first respective customer. The notification may indicate that the allocation will be performed absent selection of a reject option. In embodiments, the notification may indicate a time period within which a reject option must be submitted. The interface may indicate that the allocation will be performed within a predefined period of time absent selection of a reject option. In embodiments, the interface may comprise a transfer amount input element by which a user may input an amount of funds, which may be a maximum amount of funds, permitted to be transferred and/or allocated to the different destination depository institution. Exemplary destination institution management graphical user interfaces are shown in FIGS. **9**A-C.

In embodiments, the interface may comprise a plurality of alternate depository institution selection options, e.g., prior to the computer system allocating funds to a particular one or more different depository institutions. A user of a client device may select one or more of the alternate depository institution selection options, and then the computer system may determine the allocation based at least in part on the selection. In embodiments, the interface may comprise respective transfer amount input elements, e.g., maximum transfer amount input elements, associated with each of the one or more alternate depository institution selection options. A user may input respective amounts of funds, e.g., maximum amounts of funds, permitted to be allocated to the respective alternate depository institutions.

In a step **S1310**, the deposit sweep computer system may provide to a client device the first machine-readable instructions, causing the client device to activate an interface application to render the destination institution management graphical user interface on a display screen (e.g., an embedded display screen and/or touch screen, an external display screen, a projector, to name a few) operatively connected to the client device.

In a step **S1312**, the deposit sweep computer system may receive from the client device an approval of the allocation via the graphical accept option of the destination institution management graphical user interface. In embodiments, approvals and/or rejections may be stored in one or more databases, e.g., for future access. Accordingly, the deposit sweep computer system may store in one or more databases comprising non-transitory computer-readable memory an indication of the approval of the allocation. The indication may comprise an identification of the different destination depository institution, which may comprise a database identifier.

In embodiments, the deposit sweep computer system may receive from the client device, along with the approval of the allocation, a transfer amount via a transfer amount input element of the destination institution management graphical user interface. The transfer amount may be a maximum permissible transfer amount specified by the user. The computer system may determine an updated allocation of funds based at least in part upon the transfer amount. The computer system may then executed the updated allocation of funds.

In a step **S1314**, the deposit sweep computer system may execute the allocations of funds. In embodiments, executing the allocations of funds may comprise one or more transfers of funds according to the determined allocations. In embodiments, executing the allocations of funds may comprise inserting and/or modifying electronic entries in one or more electronic ledgers, which may comprise one or more databases.

In embodiments, the process may be repeated for one or more other customers, such as a second respective customer. Accordingly, in embodiments the method may further comprise prior to executing the allocations of funds, determining, by the deposit sweep computer system, for a second respective customer that at least one of the one or more respective destination depository institutions is a respective different destination depository institution for the second respective customer, the respective different destination depository institution not currently holding customer funds for the deposit sweep program for the second respective customer; generating, by the deposit sweep computer system, second machine-readable instructions to render a respective destination institution management graphical user interface comprising a respective different destination depository institution notification indicating that at least a portion of the customer funds of the second respective customer are allocated to the respective different destination depository institution and further comprising a respective graphical accept option to approve the allocation and a respective graphical reject option to reject the allocation; providing, by the deposit sweep computer system to a second client device associated with the second respective customer, the second machine-readable instructions, causing the second client device to activate a respective interface application to render the respective destination institution management graphical user interface on a respective display screen operatively connected to the second client device; receiving, at the deposit sweep computer system from the second client device, a respective approval of the allocation via the respective graphical accept option of the respective destination institution management graphical user interface; and executing, by the deposit sweep computer system, the allocations of funds.

In embodiments, a system for performing a deposit sweep transaction with customer control can comprise one or more processors and non-transitory computer-readable memory having stored thereon instructions to perform the steps of receiving, at a deposit sweep computer system comprising

one or more computers, a deposit sweep file for a deposit sweep program, the deposit sweep file comprising transaction information; determining, by the deposit sweep computer system based at least in part upon the transaction information, allocations of funds for a plurality of customers, the allocations comprising identifications for each respective customer of one or more respective destination depository institutions and respective amounts to allocate to each respective destination depository institution; determining, by the deposit sweep computer system, for a first respective customer that at least one of the one or more respective destination depository institutions is a different destination depository institution for the first respective customer, the different destination depository institution not currently holding customer funds for the deposit sweep program for the first respective customer; generating, by the deposit sweep computer system, first machine-readable instructions to render a destination institution management graphical user interface comprising a different destination depository institution notification indicating that at least a portion of the customer funds are allocated to the different destination depository institution and further comprising a graphical accept option to approve the allocation and a graphical reject option to reject the allocation; providing, by the deposit sweep computer system to a client device, the first machine-readable instructions, causing the client device to activate an interface application to render the destination institution management graphical user interface on a display screen operatively connected to the client device; receiving, at the deposit sweep computer system from the client device, an approval of the allocation via the graphical accept option of the destination institution management graphical user interface; and executing, by the deposit sweep computer system, the allocations of funds.

In embodiments, a client device, which may be a mobile device such as a mobile phone, may comprise one or more processors and non-transitory computer-readable memory having stored thereon computer-readable instructions to perform the steps of receiving, at client device associated with a first respective customer from a deposit sweep computer system, first machine-readable instructions to render a destination institution management graphical user interface comprising first display data comprising a different destination depository institution notification indicating that at least a portion of the customer funds are allocated to a different destination depository institution not currently holding funds of the first respective customer, the destination institution management graphical user interface further comprising a graphical accept option to approve the allocation of funds and a graphical reject option to reject the allocation; activating, by the client device an interface application to render the destination institution management graphical user interface on a display screen operatively connected to the client device; receiving, at the client device via an input device, a user selection of the graphical accept option; transmitting, from the client device to the deposit sweep computer system, an electronic approval of the allocation corresponding to the user selection of the graphical reject option; and receiving, at the client device, an electronic notification of an execution of the allocation of funds. In embodiments, the client device may include a dedicated application (e.g., a mobile app) configured to interact with the deposit sweep computer system. Such an application may be activated automatically upon receipt of data and/or instructions from a deposit sweep computer system or from a source institution or depository institution.

FIGS. **13B-1-13B-2** are flow charts of a process for performing deposit sweep transactions that comprises providing customer control in an automated deposit sweep transaction in accordance with exemplary embodiments of the present invention in which the customer rejects a proposed allocation of funds to a new depository institution.

In a step **S1322**, a deposit sweep computer system comprising one or more computers may receive a deposit sweep file for a deposit sweep program. The deposit sweep file may comprise transaction information (e.g., for pending and/or completed transactions, such as amounts transferred to respective accounts and/or amounts transferred from respective accounts) and/or account balance information.

In a step **S1324**, the deposit sweep computer system may determine, based at least in part upon the transaction information, allocations of funds for a plurality of customers. The allocations may comprise identifications for each respective customer of one or more respective destination depository institutions and respective amounts to allocate to each respective destination depository institution. In embodiments, the allocations may comprise identifications of source accounts, e.g., trading accounts, from which to transfer funds to the respective destination depository institutions.

In a step **S1326**, the deposit sweep computer system may determine for a first respective customer that at least one of the one or more respective destination depository institutions is a different destination depository institution for the first respective customer, as described herein. The different destination depository institution may not currently hold customer funds for the deposit sweep program for the first respective customer.

In a step **S1328**, the deposit sweep computer system may generate first machine-readable instructions to render a destination institution management graphical user interface. The interface may comprise first display data comprising a different destination depository institution notification indicating that at least a portion of the customer funds are allocated to the different destination depository institution. The different destination depository institution notification may comprise an indication of the amount of funds allocated to the different depository institution for the first respective customer. The interface may further comprise a graphical accept option to approve the allocation and/or a graphical reject option to reject the allocation. In embodiments, an accept option may not be provided, and approvals may be handled as the default option unless a reject option is selected.

In a step **S1330**, the deposit sweep computer system may provide to a client device associated with the first respective customer the first machine-readable instructions, causing the client device to activate an interface application to render the destination institution management graphical user interface on a display screen operatively connected to the client device. In embodiments, activating the interface application may comprise causing the interface application to receive the first machine-readable instructions and render the destination institution management graphical user interface. An interface application may be a dedicated application, such as a preinstalled application or a downloadable application, for deposit sweep management, account management, or other financial management. In embodiments, an interface application may be a web browser application configured to render graphical content, e.g., associated with one or more webpages.

In a step **S1332**, the deposit sweep computer system may receive from the client device a rejection of the allocation

via the graphical reject option of the destination institution management graphical user interface. In embodiments, an indication of the rejection may be stored in one or more databases. Such an indication may comprise an identification of the different destination depository institution.

In a step **S1334**, the deposit sweep computer system may generate second machine-readable instructions to render an updated destination institution management graphical user interface comprising second display data. The second display data can comprise one or more alternate depository institution selection options. In embodiments, a GUI showing one or more depository institution options may be provided to a user prior to determining an allocation of funds and/or prior to receiving a rejection of a first proposed allocation. In embodiments, the updated destination institution management GUI may comprise respective transfer amount input elements associated with each of the one or more alternate depository institution selection options. A user may input, via such input elements, respective amounts of funds to allocate or maximum amounts of funds permitted to be allocated to the respective alternate depository institutions.

In a step **S1336**, the deposit sweep computer system may provide to the client device the second machine-readable instructions, causing the client device to render the updated destination institution management graphical user interface. In other embodiments, the second machine-readable instructions may be part of the first machine-readable instructions so that upon a user selection of a reject option the client device already has the data required to display the alternate depository institution selection options.

In a step **S1338**, the deposit sweep computer system may receive from the client device via the updated destination institution management graphical user interface a selection of at least one of the alternate depository institution selection options. In embodiments, selections of a plurality of permissible alternate depository institutions may be received. In embodiments, indications of such selections may be stored in one or more databases. Such indications can include identifications of the alternate depository institutions associated with the alternate depository institution selections.

In a step **S1340**, the deposit sweep computer system may determine an updated allocation of funds. The updated allocation of funds may be based at least in part upon the rejection of the first allocation and/or the selection of alternate depository institutions. The updated allocation of funds may also be based at least in part upon the initial allocation, relying upon the user's inputs to determine an updated allocation that satisfies the allocation criteria (e.g., moving a certain amount of funds out of a particular depository institution or to a particular depository institution) while satisfying the user's preferences. The computer system may allocate a portion of funds of the first respective customer to the at least one selected alternate depository institution. In embodiments, the allocation and notification process may be repeated if the reallocation results in additional different destination depository institutions for other customers.

In a step **S1342**, the deposit sweep computer system may execute the updated allocations of funds. In embodiments, executing the updated allocations can comprise creating and/or modifying electronic ledger entries. In embodiments, executing the updated allocations can comprise performing transfers of funds, e.g., by transmitting transaction instructions such as ACH instructions to one or more institutions.

In embodiments, the process may be repeated for one or more other customers, such as a second respective customer.

In embodiments, a system for performing a deposit sweep transaction with customer control can comprise one or more processors and non-transitory computer-readable memory having stored thereon instructions to perform the steps of receiving, at a deposit sweep computer system comprising one or more computers, a deposit sweep file for a deposit sweep program, the deposit sweep file comprising transaction information; determining, by the deposit sweep computer system based at least in part upon the transaction information, allocations of funds for a plurality of customers, the allocations comprising identifications for each respective customer of one or more respective destination depository institutions and respective amounts to allocate to each respective destination depository institution; determining, by the deposit sweep computer system, for a first respective customer that at least one of the one or more respective destination depository institutions is a different destination depository institution for the first respective customer, the different destination depository institution not currently holding customer funds for the deposit sweep program for the first respective customer; generating, by the deposit sweep computer system, first machine-readable instructions to render a destination institution management graphical user interface comprising first display data comprising a different destination depository institution notification indicating that at least a portion of the customer funds are allocated to the different destination depository institution and further comprising a graphical accept option to approve the allocation and a graphical reject option to reject the allocation; providing, by the deposit sweep computer system to a client device, the first machine-readable instructions, causing the client device to activate an interface application to render the destination institution management graphical user interface on a display screen operatively connected to the client device; receiving, at the deposit sweep computer system from the client device, a rejection of the allocation via the graphical reject option of the destination institution management graphical user interface; generating, by the deposit sweep computer system, second machine-readable instructions to render an updated destination institution management graphical user interface comprising second display data, the second display data comprising one or more alternate depository institution selection options; providing, by the deposit sweep computer system to the client device, the second machine-readable instructions, causing the client device to render the updated destination institution management graphical user interface; receiving, at the deposit sweep computer system from the client device via the updated destination institution management graphical user interface, an alternate depository institution selection comprising a selection of at least one of the alternate depository institution selection options; determining, by the deposit sweep computer system, an updated allocation of funds based at least in part upon the alternate depository institution selection; and executing, by the deposit sweep computer system, the updated allocations of funds.

In embodiments, a client device, which may be a mobile device such as a mobile phone, may comprise one or more processors and non-transitory computer-readable memory having stored thereon computer-readable instructions to perform the steps of receiving, at client device associated with a first respective customer from a deposit sweep computer system, first machine-readable instructions to render a destination institution management graphical user interface comprising first display data comprising a different destination depository institution notification indicating that at least a portion of the customer funds are allocated to a

different destination depository institution not currently holding funds of the first respective customer, the destination institution management graphical user interface further comprising a graphical accept option to approve the allocation and a graphical reject option to reject the allocation; activating, by the client device an interface application to render the destination institution management graphical user interface on a display screen operatively connected to the client device; receiving, at the client device via an input device, a user selection of the graphical reject option; transmitting, from the client device to the deposit sweep computer system, an electronic rejection of the allocation corresponding to the user selection of the graphical reject option; receiving, at the client device from the deposit sweep computer system, second machine-readable instructions to render an updated destination institution management graphical user interface comprising second display data, the second display data comprising one or more alternate depository institution selection options; rendering, by the client device the updated destination institution management graphical user interface on the display screen; receiving, at the client device via an input device, an alternate depository institution selection comprising a user selection of at least one of the alternate depository institution selection options; transmitting, from the client device to the deposit sweep computer system, the alternate depository institution selection; receiving, at the client device, an electronic notification of an updated allocation of funds, wherein the allocation does not allocate funds to the different destination depository institution and wherein the allocation allocates funds to an alternate depository institution associated with the alternate depository institution selection. In embodiments, the client device may include a dedicated application (e.g., a mobile app) configured to interact with the deposit sweep computer system. Such an application may be activated automatically upon receipt of data and/or instructions from a deposit sweep computer system or from a source institution or depository institution.

FIGS. **13C-1-13C-2** are flow charts of a process for performing deposit sweep transactions comprising providing customer control in automated deposit sweep transactions in accordance with exemplary embodiments of the present invention in which a plurality of customers provide input as to destination depository institutions.

In a step **S1352**, a deposit sweep computer system comprising one or more computers may receive a deposit sweep file for a deposit sweep program, the deposit sweep file comprising transaction information.

In a step **S1354**, the deposit sweep computer system may determine, based at least in part upon the transaction information, first allocations of funds for a plurality of customers. The first allocations may comprise for each respective customer at least identifications of one or more respective destination depository institutions and respective amounts to allocate to each respective destination depository institution.

In a step **S1356**, the deposit sweep computer system may determine for a first subset of the plurality of customers that for each respective customer of the first subset of the plurality of customers at least one of the respective destination depository institutions is a respective different destination depository institution. Such a respective different destination depository institution may not currently hold customer funds for the respective customer for the deposit sweep program. In embodiments, the different destination depository institution may be determined based at least in part upon other criteria, such as whether the institution holds any customer funds and/or historical holding of funds for the customer.

In a step **S1358**, the deposit sweep computer system may generate respective first machine-readable instructions to render respective destination institution management graphical user interfaces. Each interface may comprise respective first display data, which in turn may comprise a different destination depository institution notification indicating that at least a portion of the funds of the respective customer are allocated to the respective different destination depository institution. The interface may further comprise a respective graphical accept option to approve the respective allocation and a respective graphical reject option to reject the respective allocation.

In a step **S1360**, the deposit sweep computer system may provide to a plurality of respective client devices each associated with one of the respective customers of the first subset of the plurality of customers the respective first computer-readable instructions, causing each respective client device to activate a respective interface application to render the respective destination institution management graphical user interface on a respective display screen operatively connected to the respective client device. In embodiments, the respective first machine-readable instructions may be provided to a plurality of client devices associated with a particular customer.

In a step **S1362**, the deposit sweep computer system may receive from a first subset of the respective client devices within a predefined period of time (e.g., 5 minutes, 15 minutes, 1 hour, 1 day, to name a few), respective approvals of the respective different destination depository institutions via respective selections of the respective accept options.

In a step **S1364**, the deposit sweep computer system may receive from a second subset of the respective client devices within the predefined period of time, respective rejections of the respective different destination depository institutions via respective selections of the respective reject options. In embodiments, non-responses may be treated as approvals. In embodiments, the respective rejections may comprise respective selections of one or more alternate destination depository institutions. The respective reject options may comprise respective alternate destination depository institution selection options.

In embodiments, the deposit sweep computer system may determine a third subset of the respective client devices comprising those of the plurality of respective client devices not included in the first subset or the second subset of the respective client devices. Accordingly, the third subset of the respective client devices is comprised of those client devices that did not respond (e.g., accept or reject the respective first allocation) within the predefined period of time. In embodiments, the third subset may comprise a subset of deposit sweep customers for whom responses were not received, e.g., from their respective client devices. The deposit sweep computer system may handle non-responses as approvals. Accordingly, the deposit sweep computer system may determine and/or assign respective approvals of the respective different destination depository institutions for each respective client device of the third subset of the respective client devices. In embodiments, such default approvals for the non-responsive customers may be temporary approvals for the first allocation, and subsequent allocations to the respective different destination depository institutions may re-trigger this different destination depository institution notification process.

In embodiments, a selection of an accept option, a reject option, and/or one or more alternate depository institution selection options that is received after the predefined period of time may be stored for use with future deposit sweep allocations of funds. However, the current deposit sweep transaction may be performed using the respective first allocation of funds.

In a step **S1366**, the deposit sweep computer system may determine second allocations of funds for the plurality of customers, the second allocations based at least in part upon the transaction information, the first allocations, and the respective rejections. The second allocations of funds may not include allocations of funds for the plurality of customers to the respective different destination depository institutions associated with the respective rejections.

In embodiments, the deposit sweep computer system may generate for each of the second subset of the respective client devices, respective second machine-readable instructions to render respective updated destination institution management graphical user interfaces each comprising respective second display data comprising one or more respective alternate depository institution selection options. The deposit sweep computer system may provide the respective second machine-readable instructions to the second subset of the respective client devices, which may cause each respective client device to render the respective updated destination institution management graphical user interface. The deposit sweep computer system may receive from one or more of the second subset of the respective client devices, e.g., via the respective updated destination institution management graphical user interfaces, respective alternate depository institution selections comprising respective selections of at least one of the respective alternate depository institution selection options. Accordingly, second allocations of funds for the plurality of customers may be based at least in part upon the transaction information, the first allocations, and the respective alternate depository institution selections.

In a step **S1368**, the deposit sweep computer system may execute the second allocations of funds. In embodiments, executing the second allocations of funds may comprise updating an electronic ledger, such as by creating or updating electronic ledger entries. In embodiments, executing the second allocations of funds may comprise performing or initiating a plurality of transfers of funds according to the second allocations of funds.

In embodiments, a system for performing a deposit sweep transaction with customer control can comprise one or more processors and non-transitory computer-readable memory having stored thereon instructions to perform the steps of receiving, at a deposit sweep computer system comprising one or more computers, a deposit sweep file for a deposit sweep program, the deposit sweep file comprising transaction information; determining, by the deposit sweep computer system based at least in part upon the transaction information, first allocations of funds for a plurality of customers, the first allocations comprising for each respective customer identifications of one or more respective destination depository institutions and respective amounts to allocate to each respective destination depository institution; determining, by the deposit sweep computer system, for a first subset of the plurality of customers that for each respective customer of the first subset of the plurality of customers at least one of the respective destination depository institutions is a respective different destination depository institution, the respective different destination depository institution not currently holding funds of the respective customer for the deposit sweep program; generating, by the deposit sweep computer system, respective first machine-readable instructions to render respective destination institution management graphical user interfaces each comprising respective first display data comprising a different destination depository institution notification indicating that at least a portion of the funds of the respective customer are allocated to the respective different destination depository institution and further comprising a respective graphical accept option to approve the respective allocation and a respective graphical reject option to reject the respective allocation; providing, by the deposit sweep computer system to a plurality of respective client devices each associated with one of the respective customers of the first subset of the plurality of customers, the respective first computer-readable instructions causing each respective client device to activate a respective interface application to render the respective destination institution management graphical user interface on a respective display screen operatively connected to the respective client device; receiving, at the deposit sweep computer system from a first subset of the respective client devices within a predefined period of time, respective approvals of the respective different destination depository institutions via respective selections of the respective accept options; receiving, at the deposit sweep computer system from a second subset of the respective client devices within the predefined period of time, respective rejections of the respective different destination depository institutions via respective selections of the respective reject options; determining, by the deposit sweep computer system, second allocations of funds for the plurality of customers, the second allocations based at least in part upon the transaction information, the first allocations, and the respective rejections; and executing, by the deposit sweep computer system, the second allocations of funds.

The systems, methods, and program products described herein with respect to deposit sweep transactions and associated destination depository institutions may also apply to other cash sweep transactions and their associated destination institutions. For example, in embodiments a system for performing a cash sweep transaction with customer control can comprise one or more processors and non-transitory computer-readable memory having stored thereon instructions to perform the steps of receiving, at a cash sweep computer system comprising one or more computers, a cash sweep file for a cash sweep program, the cash sweep file comprising transaction information; determining, by the cash sweep computer system based at least in part upon the transaction information, first allocations of funds for a plurality of customers, the first allocations comprising for each respective customer identifications of one or more respective destination institutions (e.g., ETF providers, brokers-dealers associated with one or more ETF or money fund, capital investment plan institutions, to name a few) and respective amounts to allocate to each respective destination institution; determining, by the cash sweep computer system, for a first subset of the plurality of customers that for each respective customer of the first subset of the plurality of customers at least one of the respective destination institutions is a respective different destination institution, the respective different destination institution not currently holding funds of the respective customer for the cash sweep program; generating, by the cash sweep computer system, respective first machine-readable instructions to render respective destination institution management graphical user interfaces each comprising respective first display data comprising a different destination institution

notification indicating that at least a portion of the funds of the respective customer are allocated to the respective different destination institution and further comprising a respective graphical accept option to approve the respective allocation and a respective graphical reject option to reject the respective allocation; providing, by the cash sweep computer system to a plurality of respective client devices each associated with one of the respective customers of the first subset of the plurality of customers, the respective first computer-readable instructions causing each respective client device to activate a respective interface application to render the respective destination institution management graphical user interface on a respective display screen operatively connected to the respective client device; receiving, at the cash sweep computer system from a first subset of the respective client devices within a predefined period of time, respective approvals of the respective different destination institutions via respective selections of the respective accept options; receiving, at the cash sweep computer system from a second subset of the respective client devices within the predefined period of time, respective rejections of the respective different destination institutions via respective selections of the respective reject options; determining, by the cash sweep computer system, second allocations of funds for the plurality of customers, the second allocations based at least in part upon the transaction information, the first allocations, and the respective rejections; and executing, by the cash sweep computer system, the second allocations of funds.

The following non-limiting embodiments are provided as examples consistent with the invention. Note that these examples may be implemented in method format, system format and/or non-transitory computer-readable medium format.

In embodiments, a method example may comprise: accessing, by one or more intermediary computers, one or more databases holding transaction rules, and client authentication data for a source institution computer of a source institution and client authentication data for one or more destination institution computers of one or more destination institutions: to obtain source account balance information for the source account of the client held in the source institution, and source transaction data for the source account; to obtain destination account balance data for one or more client destination accounts held in one or more destination institutions, wherein the one or more intermediary computers are not affiliated with the source institution holding the source account or with the one or more destination institutions holding the one or more destination accounts of the client; determining, by the one by the one or more intermediary computers, if the source institution computer and/or the destination institution computer and/or a clearing firm computer of a clearing firm has an active sweep program; setting, by the one by the one or more intermediary computers, an election to deactivate use of the active sweep program when it has been determined that such sweep program is active; periodically or aperiodically directly obtaining, by the one by the one or more intermediary computers via one or more networks, the source account balance information for the source account without requiring the client's computer or the source institution computer and/or a clearing firm computer to initiate a request for access to the information; periodically or aperiodically directly obtaining, by the one by the one or more intermediary computers via one or more networks, the destination account balance information for the one or more destination accounts without requiring the client's computer or the one or more destination institution computers and/or a clearing firm computer to initiate a request for access to the information; periodically or aperiodically directly obtaining, by the one by the one or more intermediary computers via one or more networks, the source transaction data comprising one or more buy orders and/or sell orders for the source account without requiring the client's computer or the source institution computer and/or a clearing firm computer to initiate a request for access to the transaction data; transforming data, based at least in part on information in the transaction data, to determine, by the one or more intermediary computers, that the source transaction data for the source account represents a net buy order with a net buy amount; transforming data, based at least in part on the source account balance information for the source account, to determine, by the one or more intermediary computers, that a source account balance for the source account does not equal or exceed the net buy amount for the net buy order, and determining a deficiency amount; generating and directly instructing, by the one or more intermediary computers and the one or more networks, to make a fund transfer from at least one of the one or more destination accounts of at least the deficiency amount to the source account, via access to one or more servers of the one or more destination institutions using the client authentication data without requiring the client's computer or the source institution computer or the destination institution computer and/or the clearing firm computer to initiate a request for transfer; and generating and sending electronic notice, by the one or more intermediary computers and the one or more networks, of the transfer.

In embodiments, a system example may comprise: one or more intermediary computers configured: to access, by one or more intermediary computers, one or more databases holding transaction rules, and client authentication data for a source institution computer of a source institution and client authentication data for one or more destination institution computers of one or more destination institutions: to obtain source account balance information for the source account of the client held in the source institution, and source transaction data for the source account; to obtain destination account balance data for one or more client destination accounts held in one or more destination institutions, wherein the one or more intermediary computers are not affiliated with the source institution holding the source account or with the one or more destination institutions holding the one or more destination accounts of the client; to determine, by the one or more intermediary computers, if the source institution computer and/or the destination institution computer and/or a clearing firm computer of a clearing firm has an active sweep program; to set, by the one or more intermediary computers, an election to deactivate use of the active sweep program when it has been determined that such sweep program is active; to directly obtain periodically or aperiodically, by the one or more intermediary computers via one or more networks, the source account balance information for the source account without requiring the client's computer or the source institution computer and/or a clearing firm computer to initiate a request for access to the information; to directly obtain periodically or aperiodically, by the one by the one or more intermediary computers via one or more networks, the destination account balance information for the one or more destination accounts without requiring the client's computer or the one or more destination institution computers and/or a clearing firm computer to initiate a request for access to the information; to directly obtain periodically or aperiodically, by the one by

the one or more intermediary computers via one or more networks, the source transaction data comprising one or more buy orders and/or sell orders for the source account without requiring the client's computer or the source institution computer and/or a clearing firm computer to initiate a request for access to the transaction data; to transform data, by the one or more intermediary computers, based at least in part on information in the transaction data, to determine whether the source transaction data for the source account represents a net buy order with a net buy amount; to transform data, by the one or more intermediary computers, based at least in part on the source account balance information for the source account, to determine whether a source account balance for the source account does not equal or exceed the net buy amount for the net buy order, and determining a deficiency amount, when the source transaction data is a net buy order; to generate and directly instruct, by the one or more intermediary computers and the one or more networks, to make a fund transfer from at least one of the one or more destination accounts of at least the deficiency amount to the source account, via access to one or more servers of the one or more destination institutions using the client authentication data without requiring the client's computer or the source institution computer or the destination institution computer and/or the clearing firm computer to initiate a request for transfer; and to generate and send electronic notice, by the one or more intermediary computers and the one or more networks, of the transfer.

In embodiments, a method example may comprise: accessing, by one or more intermediary computers, one or more databases holding transaction rules, and client authentication data for a source institution computer of a source institution and client authentication data for one or more destination institution computers of one or more destination institutions: to obtain source account balance information for the source account of the client held in the source institution, and source transaction data for the source account; to obtain destination account balance data for one or more client destination accounts held in one or more destination institutions, wherein the one or more intermediary computers are not affiliated with the source institution holding the source account or with the one or more destination institutions holding the one or more destination accounts of the client; periodically or aperiodically obtaining, by the one by the one or more intermediary computers via one or more networks, the source account balance information for the source account, while bypassing one or more automatic fund transfer programs of the source institution computer and/or a clearing firm computer of a clearing firm and without requiring the client's computer or the source institution computer and/or a clearing firm computer to initiate a request for access to the information; periodically or aperiodically obtaining, by the one by the one or more intermediary computers via the one or more networks, the destination account balance information for the one or more destination accounts, while bypassing one or more automatic fund transfer programs of the one or more destination institution computers and/or the clearing firm computer and—without requiring the client's computer or the one or more destination institution computers and/or a clearing firm computer to initiate a request for access to the information; periodically or aperiodically obtaining, by the one by the one or more intermediary computers via the one or more networks, the source transaction data comprising one or more buy orders and/or sell orders for the source account, while bypassing the one or more automatic fund transfer programs of the source institution computer and/or the clearing firm computer and without requiring the client's computer or the source institution computer and/or a clearing firm computer to initiate a request for access to the transaction data; transforming data, by the one by the one or more intermediary computers, based at least in part on information in the transaction data, to determine, by the one or more intermediary computers, that the source transaction data for the source account represents a net buy order with a net buy amount; transforming data, by the one by the one or more intermediary computers, based at least in part on the source account balance information for the source account, to determine that a source account balance for the source account does not equal or exceed the net buy amount for the net buy order, and determining a deficiency amount; generating and sending for execution electronic transaction instructions, by the one or more intermediary computers and the one or more networks, for a transfer from at least one of the one or more destination accounts of at least the deficiency amount to the source account, via access to one or more servers of the one or more destination institutions using the client authentication data, while bypassing the one or more automatic fund transfer programs of the source and/or destination institution computers and/or the clearing firm computer and without requiring the client's computer or the source institution computer or the destination institution computer and/or the clearing firm computer to initiate a request for transfer; and generating and sending electronic notice, by the one or more intermediary computers and the one or more networks, of the transfer.

In embodiments of a method or system example the one or more intermediary computers may comprise a client computer, wherein the one or more databases comprise computer storage on the client computer that holds the client authentication data for the source institution computer and the client authentication data for the one or more destination institution computers, and wherein the accessing the client authentication data for the source institution computer and the client authentication data for the one or more destination institution computers is triggered only by authentication of the client by matching a predetermined security program.

In embodiments, a method or system example may comprise: triggering an association, by the one or more computers, of an insurance contract to insure against unauthorized transfers from the source account or the one or more destination accounts, when the predetermined security program is used for a transfer of funds.

In embodiments, a method or system example may comprise activating a limited authorization for only transfers between client accounts associated with the source institution computers and the destination institution computers and no other transfers.

In embodiments, a method or system example may comprise: triggering an association, by the one or more computers, of an insurance contract to insure against unauthorized transfers from the source account or the one or more destination accounts, to a fund transfer when the limited authorization for fund transfers is activated.

In embodiments, a method or system example may comprise determining when the source account balance information for the source account exceeds a threshold amount set in the transaction rules; and generating and sending for execution electronic transaction instructions, by the one or more intermediary computers and the one or more networks, to transfer funds from the source account to at least one of the one or more destination accounts.

In embodiments, a method or system example may comprise generating and sending an electronic notification, by

the one or more intermediary computers and the one or more networks, when the deficiency amount is greater than the destination account balance data for the one or more destination accounts.

In embodiments of a method or system example the obtaining the source transaction data, and/or the source account balance information, and/or the destination account balance information for the one or more destination accounts, may comprise receiving an automatically pushed file via the one or more networks.

In embodiments of a method or system example, the obtaining the source transaction data, and/or the source account balance information, and/or the destination account balance information for the one or more destination accounts, may comprise retrieving the source transaction data and/or the source account balance information and/or the destination account balance information, via access to a server of the source institution and/or via access to the one or more servers of the one or more destination institutions, using the client authentication data.

In embodiments of a method or system example there may be a plurality of the destination accounts.

In embodiments of a method or system example there may be a plurality of the destination accounts, and the method may further comprise: sending or making accessible automatically, by the one or more computers and via the one or more networks, destination balance information to the client for each of the destination account when the source transaction data is received or obtained.

In embodiments of a method or system example there may be a plurality of the destination accounts, and the method may further comprise: selecting one of the destination accounts from which to transfer funds, by the one or more intermediary computers, based at least in part upon one or more criteria may comprise at least one selected from the group of a client preference, minimizing a number of transfers necessary to cover the deficiency amount, and selecting one of the destination accounts which has client funds in the account that exceed an FDIC insurance limit.

In embodiments of a method or system example the electronic instructions may be ACH instructions.

In embodiments of a method or system example, when transaction data is obtained that represents a net buy order, the generating and sending or make accessible the one or more electronic instructions to transfer to the cover the deficiency amount may operate within a predetermined time period after a time associated with the source transaction data, so that the one or more buy orders are not defaulted.

In embodiments, a method or system example may comprise: maintaining, by the one or more intermediary computers, the one or more databases with the client authentication data.

In embodiments, a system example may comprise: one or more intermediary computers configured: to access, by one or more intermediary computers, one or more databases holding transaction rules, and client authentication data for a source institution computer of a source institution and client authentication data for one or more destination institution computers of one or more destination institutions: to obtain source account balance information for the source account of the client held in the source institution, and source transaction data for the source account; to obtain destination account balance data for one or more client destination accounts held in one or more destination institutions, wherein the one or more intermediary computers are not affiliated with the source institution holding the source account or with the one or more destination institutions holding the one or more destination accounts of the client; to obtain periodically or aperiodically, by the one by the one or more intermediary computers via one or more networks, the source account balance information for the source account, while bypassing one or more automatic fund transfer programs of the source institution computer and/or a clearing firm computer of a clearing firm and without requiring the client's computer or the source institution computer and/or a clearing firm computer to initiate a request for access to the information; to obtain periodically or aperiodically, by the one by the one or more intermediary computers via the one or more networks, the destination account balance information for the one or more destination accounts, while bypassing one or more automatic fund transfer programs of the one or more destination institution computers and/or the clearing firm computer and—without requiring the client's computer or the one or more destination institution computers and/or a clearing firm computer to initiate a request for access to the information; to obtain periodically or aperiodically, by the one by the one or more intermediary computers via the one or more networks, the source transaction data comprising one or more buy orders and/or sell orders for the source account, while bypassing the one or more automatic fund transfer programs of the source institution computer and/or the clearing firm computer and without requiring the client's computer or the source institution computer and/or a clearing firm computer to initiate a request for access to the transaction data; to transform data, by the one by the one or more intermediary computers, based at least in part on information in the transaction data, to determine whether the source transaction data for the source account represents a net buy order with a net buy amount; to transform data, by the one by the one or more intermediary computers, based at least in part on the source account balance information for the source account, to determine whether a source account balance for the source account does not equal or exceed the net buy amount for the net buy order, and determining a deficiency amount, when the source transaction data is a net buy order; to generate and send for execution electronic transaction instructions, by the one or more intermediary computers and the one or more networks, for a transfer from at least one of the one or more destination accounts of at least the deficiency amount to the source account, via access to one or more servers of the one or more destination institutions using the client authentication data, while bypassing the one or more automatic fund transfer programs of the source and/or destination institution computers and/or the clearing firm computer and without requiring the client's computer or the source institution computer or the destination institution computer and/or the clearing firm computer to initiate a request for transfer; and to generate and send electronic notice, by the one or more intermediary computers and the one or more networks, of the transfer.

In embodiments, a non-transitory computer-readable medium may comprise computer-readable program instructions, that when executed by one or more computers, configure the one or more computers: to access, by one or more intermediary computers, one or more databases holding transaction rules, and client authentication data for a source institution computer of a source institution and client authentication data for one or more destination institution computers of one or more destination institutions: to obtain source account balance information for the source account of the client held in the source institution, and source transaction data for the source account; to obtain destination account balance data for one or more client destination

accounts held in one or more destination institutions, wherein the one or more intermediary computers are not affiliated with the source institution holding the source account or with the one or more destination institutions holding the one or more destination accounts of the client; to obtain periodically or aperiodically, by the one by the one or more intermediary computers via one or more networks, the source account balance information for the source account, while bypassing one or more automatic fund transfer programs of the source institution computer and/or a clearing firm computer of a clearing firm and without requiring the client's computer or the source institution computer and/or a clearing firm computer to initiate a request for access to the information; to obtain periodically or aperiodically, by the one by the one or more intermediary computers via the one or more networks, the destination account balance information for the one or more destination accounts, while bypassing one or more automatic fund transfer programs of the one or more destination institution computers and/or the clearing firm computer and—without requiring the client's computer or the one or more destination institution computers and/or a clearing firm computer to initiate a request for access to the information; to obtain periodically or aperiodically, by the one by the one or more intermediary computers via the one or more networks, the source transaction data comprising one or more buy orders and/or sell orders for the source account, while bypassing the one or more automatic fund transfer programs of the source institution computer and/or the clearing firm computer and without requiring the client's computer or the source institution computer and/or a clearing firm computer to initiate a request for access to the transaction data; to transform data, by the one by the one or more intermediary computers, based at least in part on information in the transaction data, to determine whether the source transaction data for the source account represents a net buy order with a net buy amount; to transform data, by the one by the one or more intermediary computers, based at least in part on the source account balance information for the source account, to determine whether a source account balance for the source account does not equal or exceed the net buy amount for the net buy order, and determining a deficiency amount, when the source transaction data is a net buy order; to generate and send for execution electronic transaction instructions, by the one or more intermediary computers and the one or more networks, for a transfer from at least one of the one or more destination accounts of at least the deficiency amount to the source account, via access to one or more servers of the one or more destination institutions using the client authentication data, while bypassing the one or more automatic fund transfer programs of the source and/or destination institution computers and/or the clearing firm computer and without requiring the client's computer or the source institution computer or the destination institution computer and/or the clearing firm computer to initiate a request for transfer; and to generate and send electronic notice, by the one or more intermediary computers and the one or more networks, of the transfer.

The TMS system **120** may comprise, in embodiments, a computing platform for performing, controlling, and/or initiating computer-implemented operations, for example, via a server and the one or more networks. The computer platform may comprise one or more system computers and other party computers comprising one or more processors. An exemplary system may operate under the control of computer-executable instructions to carry out the process steps described herein. Computer-executable instructions comprise, for example, instructions and data which configure a general or special purpose computer system or processing device to perform a certain function or group of functions. Computer software for the system may comprise, in embodiments, a set of software objects and/or program elements comprising computer-executable instructions collectively having the ability to execute a thread or logical chain of process steps in a single processor, or independently in a plurality of processors that may be distributed, while permitting a flow of data inputs/outputs between components and systems.

Information stored in or maintained in the one or more databases may be provided in conformance with a database system format such as, but not limited to, the Structured Query Language (SQL) format. Database query and access instructions, for example, in the form of one or more scripts, may be used which, when executed by a processor, serve to access, store and retrieve data maintained in the one or more databases according to the instructions contained in the script.

The system may comprise application software instructions which may implement a user interface portion for generating interactive pages or display screens by which a user/participant may provide data to and receive information from the system and the database using a human-machine interface. In embodiments, interactive pages may include user dialog boxes for accepting user entered information. The human-machine interface may comprise a Graphical User Interface (GUI) portion for prompting the user to enter data by providing an interactive dialog box or message box instructing the user to enter particular data, or to select from among a multitude of options provided using a pull-down menu. In embodiments, a user may interact with the system via the graphical user interface by using a pointing device and/or other data entry device. The GUI portion may place the output of the system in a format for presentation to a user via the display. In embodiments, the GUI may be implemented as a sequence of Java instructions.

In embodiments of the present invention, the various program operations as described herein may be provided by the system in response to the one or more processors executing one or more sequences of computer-readable instructions contained in main memory. Such instructions may be read into main memory from another non-transitory computer-readable medium. Execution of the sequences of instructions contained in main memory may cause one or more processors of the system to perform the process steps described herein. It should be appreciated that embodiments of the system may perform fewer or additional processes as compared to those described herein. As noted, the one or more processors may be arranged in a multi-processing arrangement. In embodiments, hard-wired circuitry may be used in place of or in combination with software instructions to implement the invention. Thus, embodiments of the invention are not limited to any specific combination of hardware circuitry and software.

Computer-readable medium or computer-readable storage medium may refer to any medium that is computer-readable and participates in storing and providing instructions to the processor for execution. Such a medium may be removable or non-removable and may be non-volatile media and non-transitory media. Non-volatile media include, for example, optical or magnetic disks, such as the storage device. Common forms of computer-readable media include, for example, floppy disk, a flexible disk, hard disk, magnetic tape, any other magnetic medium, a Compact Disc Read Only Memory (CD ROM), Digital Video Disc (DVD) or any

other optical medium, punch cards, paper tape, any other physical medium with patterns of holes, a Random Access Memory (RAM), a Programmable Read Only Memory (PROM), an Erasable Programmable Read Only Memory (EPROM), a Flash EPROM, any other memory chip or cartridge, or any other tangible medium from which a computer can read computer instructions. Combinations of the above are also included within the scope of machine-readable media. Machine-executable instructions comprise, for example, instructions and data which cause a general purpose computer, special purpose computer, or a special purpose processing machine to perform a certain function or group of functions.

In embodiments, the communication system of the TMS **120** may comprise a communication interface that may be communicatively coupled to a web server configured to generate and output web content that is suitable for display using a web browser at a computing device. In embodiments, the server may generate and transmit requested information through the communication interface to a requesting terminal via Hypertext Transfer Markup Language (HTML) formatted pages, eXtensible Markup Language (XML) formatted pages, or the like, which may be provided as World Wide Web pages that may enable navigation by hyperlinks. The server program may be used to receive commands and data from clients' terminals, access and process data from various sources, and output computer-executable instructions and data using the network. Interactive pages transmitted and received using the network may conform to necessary protocols.

In embodiments, the web server may correspond to a secure web application server behind a web server program that a service provider employs to run one or more web based application programs in a secure fashion. Such a secure web application server may be configured to execute one or more web based application programs, respond to commands and data received from the clients (via a web page supported by the web server), and provide data and results to the clients. The web server and the web application server may be implemented using a single computing platform. Alternatively, it may also be implemented using multiple separate and distributed computing platforms.

As noted above, embodiments of the present invention may be practiced in a networked environment using logical connections to one or more remote computers having processors. Logical connections may include a local area network (LAN) and a wide area network (WAN) that are presented here by way of example and not limitation. Such networked environments are in office-wide or enterprise-wide computer networks, intranets and the Internet, and may use a wide variety of different communication protocols. Those skilled in the art will appreciate that such network computing environments will typically encompass many types of computer system configurations, including personal computers, hand-held devices, multi-processor systems, microprocessor-based or programmable consumer electronics, network PCs, minicomputers, mainframe computers, and the like. Embodiments of the invention may also be practiced in distributed computing environments where tasks are performed by local and remote processing devices that are linked (either by hardwired links, wireless links, or by a combination of hardwired or wireless links) through a communications network. In a distributed computing environment, program modules may be located in both local and remote memory storage devices.

Embodiments of the invention have been described in the general context of method steps which may be implemented in embodiments by a program product comprising machine-executable instructions, such as program code, for example in the form of program modules executed by machines in networked environments. Generally, program modules include routines, programs, objects, components, data structures, etc., that perform particular tasks or implement particular data types. Multi-threaded applications may be used, for example, based at least in part upon Java or C++. Machine-executable instructions, associated data structures, and program modules represent examples of program code for executing steps of the methods disclosed herein. The particular sequence of such executable instructions or associated data structures represent examples of corresponding acts for implementing the functions described in such steps.

It will be appreciated that, for clarity purposes, the above description has described embodiments of the invention with reference to different functional units and processors. However, it will be apparent that any suitable distribution of functionality between different functional units, processors or domains may be used without detracting from the invention. For example, functionality illustrated to be performed by separate processors or controllers may be performed by the same processor or controller. Hence, references to specific functional units are only to be seen as references to suitable means for providing the described functionality, rather than indicative of a strict logical or physical structure or organization.

It should be noted that although the flow charts provided herein and the claims show a specific order of method steps, it is understood that the order of these steps may differ from what is depicted and is not limiting on the invention. Also two or more steps may be performed concurrently or with partial concurrence. Such variation will depend on the software and hardware systems chosen and on designer choice. It is understood that all such variations are within the scope of the invention. Likewise, software and web implementations of the present invention may be accomplished with programming techniques with rule based logic and other logic to accomplish the various database searching steps, correlation steps, comparison steps and decision steps. It should also be noted that the word "component" as used herein and in the claims is intended to encompass implementations using one or more lines of software code, and/or hardware implementations.

All components, modes of communication, and/or processes described heretofore are interchangeable and combinable with similar components, modes of communication, and/or processes disclosed elsewhere in the specification, unless an express indication is made to the contrary. It is intended that any structure or step of an embodiments disclosed herein may be combined with other structure and or method embodiments to form further embodiments with this added element or step.

While this invention has been described in conjunction with the exemplary embodiments outlined above, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, the exemplary embodiments of the invention, as set forth above, are intended to be illustrative, not limiting. Various changes may be made without departing from the spirit and scope of the invention.

What is claimed:

1. A method for generating and using a secure biometric-based cryptographic key without storing biometric information in order to authenticate data in a deposit sweep transfer system comprising:

(a) receiving, at a client device associated with a deposit sweep customer, from a deposit sweep computer system comprising one or more computers, first machine-readable instructions to render a destination institution management graphical user interface, the destination institution management graphical user interface comprising a different destination depository institution notification associated with a first allocation of funds indicating that at least a portion of customer funds associated with the deposit sweep customer are allocated to a different destination depository institution that does not currently hold funds for the deposit sweep customer for the deposit sweep program, the destination institution management graphical user interface further comprising a graphical accept option to approve the first allocation of funds and a graphical reject option to reject the first allocation of funds;

(b) rendering, by the client device using the first machine-readable instructions, the destination institution management graphical user interface on a display screen operatively connected to the client device;

(c) receiving, at the client device, a selection of the graphical accept option;

(d) generating, by the client device, a digitally signed approval of the first allocation of funds by:

(1) receiving, via a second graphical user interface on the client device, a user password associated with the customer;

(2) capturing, using a biometric reader embedded in the client device, into a secure enclave processor core, a first digital biometric image of a biometric reading of a user, wherein the secure enclave processor core is only accessible to input passwords, digital biometric image data, and electronic messages targeted for encryption, and to receive from the secure enclave processor core encrypted electronic messages and public keys configured to verify the authenticity of encrypted electronic messages;

(3) converting, by the secure enclave processor core, the first digital biometric image into an invariant biometric feature vector using an integrated wavelet and Fourier-Mellin transformation process comprising the following steps within the secure enclave processor core:

(i) applying, by the secure enclave processor core, a wavelet transformation to the first digital biometric image to generate a second digital biometric image;

(ii) applying, by the secure enclave processor core, a fast Fourier transform to the second digital biometric image, to generate a third digital biometric image;

(iii) applying, by the secure enclave processor core, a log-polar transformation to the third digital biometric image to generate a fourth digital biometric image;

(iv) applying, by the secure enclave processor core, a high pass filter to the fourth digital biometric image to generate a fifth digital biometric image;

(v) applying, by the secure enclave processor core, a fast Fourier transform to the fifth digital biometric image to generate a first set of feature data;

(vi) applying, by the secure enclave processor core, row concatenation to the first set of feature data to generate the invariant biometric feature vector;

(4) converting, by the secure enclave processor core, the invariant feature vector using the user password into a 128-bit invariant code comprising the following steps within the secure enclave processor core:

(i) generating, by the secure enclave processor core, using the user password a threshold intensity value;

(ii) applying, by the secure enclave processor core, the threshold intensity value to the invariant feature vector to generate the 128-bit invariant code;

(5) generating, by the secure enclave processor core, an invariant asymmetric private key using the 128-bit invariant code and the user password;

(6) applying, by the secure enclave processor core, the invariant asymmetric private key to an electronic message comprising a message payload indicating approval of the allocation to generate a digitally signed electronic message comprising the digitally signed approval to be securely transmitted to the deposit sweep computer system; and

(e) transmitting, from the client device to the deposit sweep computer system, the digitally signed approval of the allocation.

2. The method of claim **1**, wherein the display screen is embedded in the client device.

3. The method of claim **1**, wherein the digitally signed approval of the allocation can be verified by the deposit sweep computer system using a public key corresponding to the invariant asymmetric private key.

4. The method of claim **1**, wherein the client device comprises a dedicated application configured to interact with the deposit sweep computer system.

5. The method of claim **4**, wherein the dedicated application is activated, upon receipt of the first machine-readable instructions, to render the destination institution management graphical user interface.

6. The method of claim **1**, wherein the different destination depository institution notification comprises an indication of the amount of funds allocated to the different destination depository institution for the customer.

7. The method of claim **1**, wherein the destination institution management graphical user interface further comprises a transfer amount input element by which the customer may input a maximum amount of funds permitted to be allocated to the different destination depository institution.

8. The method of claim **1**, wherein the user password is received via an input device comprising any of a keyboard, keypad, pointer device, or touch screen.

9. The method of claim **1**, wherein the biometric reader is a fingerprint scanner.

10. The method of claim **1**, wherein generating a threshold intensity value using the user password comprises:

(a) obtaining, by the secure enclave processor core, a numeric value from the user password; and

(b) normalizing, by the secure enclave processor core, the numeric value within a predefined intensity range of possible intensity values by scaling the numeric value based at least in part upon a relation between a range of possible numeric values and the predefined intensity range.

11. A method for generating and using a secure biometric-based cryptographic key without storing biometric information in order to authenticate data in a deposit sweep transfer system comprising:

(a) receiving, at a client device associated with a deposit sweep customer, from a deposit sweep computer system comprising one or more computers, first machine-readable instructions to render a destination institution

management graphical user interface, the destination institution management graphical user interface comprising a different destination depository institution notification associated with a first allocation of funds indicating that at least a portion of customer funds associated with the deposit sweep customer are allocated to a different destination depository institution that does not currently hold funds for the deposit sweep customer for the deposit sweep program, the destination institution management graphical user interface further comprising a graphical accept option to approve the first allocation of funds and a graphical reject option to reject the first allocation of funds;

(b) rendering, by the client device using the first machine-readable instructions, the destination institution management graphical user interface on a display screen operatively connected to the client device;

(c) receiving, at the client device, a selection of the graphical reject option;

(d) generating, by the client device, a digitally signed rejection of the first allocation of funds by:

(1) receiving, via a second graphical user interface on the client device, a user password associated with the customer;

(2) capturing, using a biometric reader embedded in the client device, into a secure enclave processor core, a first digital biometric image of a biometric reading of a user, wherein the secure enclave processor core is only accessible to input passwords, digital biometric image data, and electronic messages targeted for encryption, and to receive from the secure enclave processor core encrypted electronic messages and public keys configured to verify the authenticity of encrypted electronic messages;

(3) converting, by the secure enclave processor core, the first digital biometric image into an invariant biometric feature vector using an integrated wavelet and Fourier-Mellin transformation process comprising the following steps within the secure enclave processor core:

(i) applying, by the secure enclave processor core, a wavelet transformation to the first digital biometric image to generate a second digital biometric image;

(ii) applying, by the secure enclave processor core, a fast Fourier transform to the second digital biometric image, to generate a third digital biometric image;

(iii) applying, by the secure enclave processor core, a log-polar transformation to the third digital biometric image to generate a fourth digital biometric image;

(iv) applying, by the secure enclave processor core, a high pass filter to the fourth digital biometric image to generate a fifth digital biometric image;

(v) applying, by the secure enclave processor core, a fast Fourier transform to the fifth digital biometric image to generate a first set of feature data;

(vi) applying, by the secure enclave processor core, row concatenation to the first set of feature data to generate the invariant biometric feature vector;

(4) converting, by the secure enclave processor core, the invariant feature vector using the user password into a 128-bit invariant code comprising the following steps within the secure enclave processor core:

(i) generating, by the secure enclave processor core, using the user password a threshold intensity value;

(ii) applying, by the secure enclave processor core, the threshold intensity value to the invariant feature vector to generate the 128-bit invariant code;

(5) generating, by the secure enclave processor core, an invariant asymmetric private key using the 128-bit invariant code and the user password;

(6) applying, by the secure enclave processor core, the invariant asymmetric private key to an electronic message comprising a message payload indicating rejection of the allocation to generate a digitally signed electronic message comprising the digitally signed rejection to be securely transmitted to the deposit sweep computer system; and

(e) transmitting, from the client device to the deposit sweep computer system, the digitally signed rejection of the allocation.

12. The method of claim **11**, further comprising:

(f) receiving, at the client device from the deposit sweep computer system, second machine-readable instructions to render an updated destination institution management graphical user interface comprising one or more alternate depository institution selection options;

(g) rendering, by the client device using the second machine-readable instructions, the updated destination institution management graphical user interface on the display screen;

(h) receiving, at the client device, a selection of at least one of the alternate depository institution selection options;

(i) generating, by the client device, a digitally signed alternate depository institution selection by applying, by the secure enclave processor core, the invariant asymmetric private key to a second electronic message comprising a second message payload indicating the selection of the at least one of the alternate depository institution selection options to generate a second digitally signed electronic message comprising the digitally signed alternate depository institution selection to be securely transmitted to the deposit sweep computer system; and

(j) transmitting, from the client device to the deposit sweep computer system, the digitally signed alternate depository institution selection.

13. The method of claim **11**, wherein the display screen is embedded in the client device.

14. The method of claim **11**, wherein the digitally signed rejection of the allocation can be verified by the deposit sweep computer system using a public key corresponding to the invariant asymmetric private key.

15. The method of claim **11**, wherein the client device comprises a dedicated application configured to interact with the deposit sweep computer system.

16. The method of claim **15**, wherein the dedicated application is activated, upon receipt of the first machine-readable instructions or the second machine-readable instructions, to render respectively the destination institution management graphical user interface or the updated destination institution management graphical user interface.

17. The method of claim **11**, wherein the different destination depository institution notification comprises an indication of the amount of funds allocated to the different destination depository institution for the customer.

18. The method of claim **11**, wherein the destination institution management graphical user interface further

comprises a transfer amount input element by which the customer may input a maximum amount of funds permitted to be allocated to the different destination depository institution.

19. The method of claim **11**, wherein the biometric reader is a fingerprint scanner.

20. The method of claim **1**, wherein generating a threshold intensity value using the user password comprises:

(a) obtaining, by the secure enclave processor core, a numeric value from the user password; and

normalizing, by the secure enclave processor core, the numeric value within a predefined intensity range of possible intensity values by scaling the numeric value based at least in part upon a relation between a range of possible numeric values and the predefined intensity range.

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